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OBSERVATIONS OF ROCKY MOUNTAIN GOATS ON MOUNT WARDLE, KOOTENAY NATIONAL PARK, BRITISH COLUMBIA

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Probably no large mammal in the Canadian Rockies has received less study than the Rocky Mountain goat (*Oreamnos americanus*). During 1962, 1963 and early 1964, I had the good fortune to live adjacent to a readily accessible goat range. During that period my duties as District Park Warden brought me into frequent contact with goats and I was able to spend a considerable amount of time observing them, often at close range, and recording their activities. The more significant of these observations are recorded here in the hope that they will help to further our knowledge of this unique species.

Description of the Study Area

Location

The study area is bisected by the 51st parallel of latitude and the 116th meridian. Mt. Wardle occupies the southern extremity of the Vermilion Range which is the second mountain range west of the continental divide, in Kootenay National Park, British Columbia. It lies about five miles north of the confluence of the Vermilion and the Kootenay Rivers and divides the two watersheds. Goats on this range occupy an area about five miles long and four miles wide, extending along both the north-east and south-west slopes of the mountain (Figure 1). In altitude their distribution extends from about 4000 feet on the valley floor to the summit of Mt. Wardle which is about 9200 feet.

Nature of the range

Most of this goat range is quite open. Much of it was once covered with Douglas fir (*Pseudotsuga menziesii*), which was largely destroyed by fire many years ago. Some isolated clumps of mature Douglas fir remain and some second growth fir along with second growth lodgepole pine (*Pinus contorta* var. *latifolia*) and aspen poplar (*Populus tremuloides*) have become established on some of the lower slopes. The north-east facing part of the area is very rough, rocky and precipitous, with broken ledges, cliffs, avalanche slopes and little timber over 5000 feet. The south-west slope of the range is less steep and rugged, consisting of scree and talus slopes and some grassed slopes which are interspersed with rock ridges and cliffs. Timber is also sparse here above the 5000 foot level.

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TABLE 1.—Kid and yearling ratios on Mount Wardle, 1962, 1963 and 1964

Date	Total Seen	Kids	Yearlings	% Kids	% Yearlings
June 25, 1962	40	13	9	32.5	22.5
July 2	35	12		34.28	
April 9, 1963	14	7		50.	
May 24	21	3*	8	14.28*	38.09
May 25	19	1*	7	5.26*	36.84
May 25	47	9*	11	19.15*	23.40
May 26	53	14*	14	28.30*	28.30
May 27	63	18	16	28.57	25.39
May 30	40	11	10	27.5	25.
July 2	25	8	7	32.	28.
July 4	30	13		43.33	
July 4	8	2		25.	
Nov. 14	7	2		28.57	
Nov. 20	35	12		34.28	
Nov. 28	16	6		37.5	
Jan. 9, 1964	29	9		31.03	
Jan. 14	10	4		40.	
Jan. 20	43	14		32.55	
Jan. 23	53	17		32.07	
Feb. 3	50	15		30.	

*Counts made during kidding period and thus kid crop not complete

Climate

This range is fairly dry, receiving less moisture and more wind than much of the surrounding country. Both of these factors contribute to the suitability of the mountain as a goat range in spite of the sparseness of vegetation. Light snowfall and strong winds, which remove snow from the exposed sites, both contribute to the availability of forage in winter.

Temperatures in the area range between —40 degrees (or colder in a few instances), in winter to the high 80's and occasionally 90's in summer. Extreme cold periods are usually of short duration.

POPULATION SIZE AND COMPOSITION

Goat numbers

Counts were taken from the valley floor as well as while on foot patrol of the range. Binoculars (9 x 50) were used when needed. Counts were taken to determine population size at times when goat distribution was most concentrated.

A total of 50 goats was counted in the band on October 30, 1962. On May 6, 1963, 55 were counted, before any young of the year were born. On November 13, a total of 62 was counted and another count taken November 14 included seven not seen the day before, bringing the known population to 69. I interpret this increase in size of count to reflect an actual population increase rather than an increase in experience on the part of the observer in finding goats. If an absolute count could be taken, I doubt that there would be more than 75 in the band at the time of this writing.

FIGURE 1. Map illustrates location of study area and approximate extent of summer and winter range. Scale: 2 miles to 1 inch.

Herd composition

The age classes of goats observed throughout the year are summarized in Table 1. In order to eliminate bias, identification of goats in groups was included only if every member of the group could be identified.

Yearlings made up 28.4 per cent, and kids 33.7 per cent of all recorded observations. The percentage of kids is computed with the exclusion of those

counts taken during kidding time. As the crop of kids was not complete such counts would be misleading.

The sexual composition of groups of goats is difficult to determine. It is almost impossible to determine sex of young kids from any distance. Mature goats are fairly easy to sex at close range, but almost every group contains an individual or two about which one cannot be certain, especially in the age groups from one to three years old. Thus a quantitative compilation of sex ratio data has not been attempted. However, the number of mature males is certainly less than that of mature females on this range.

GOAT CHARACTERISTICS

Pelage and molt

The goats in this area attained their full coats by late fall; by November guard hair was very long and wool undercoat was extremely heavy and thick. At that time they were very clean and white. Beards were long and thick as were the "knickers" which extend to the wrist joints and hocks. This coat was maintained throughout the winter into late spring and even early summer. In the month of June many goats were seen wallowing in dirt baths, and pawing dirt over their backs. They sometimes laid on one side and rubbed back and forth with legs and head, while at other times they laid upright, pawing dirt over themselves with a "side arm" movement of the front legs. The hair loosened gradually and began to come off on bushes, rocks, and in dirt wallows. If the weather is hot at this time they are obviously uncomfortable and can be seen panting, even when standing still or lying down. If there are any old snow banks in the area they will lie on them to keep cool.

Yearling goats were the first to shed completely. This is contrary to Casebeer, Rognrud and Brandborg (1950) who studied goats in Montana. Those authors found that yearling goats were later in shedding than older age groups. On June 25, 1962, yearling goats on Mount Wardle were completely shed while older animals still carried considerable winter hair. On July 13 two mature males had shed their winter coats with the exception of a few small patches of old hair.

Shedding starts around the head, neck, and shoulders, where rubbing and scratching is the easiest. During June and early July, goats on Mount Wardle are at their poorest in appearance, although they may have improved slightly in flesh since April. During shedding, great patches of hair and wool could be seen hanging from the legs and bodies of the goats and were frequently found snagged on bushes and trees where the goats had passed. The goats are very dirty at this time and often become so discoloured that they blend very well with the grey limestone and can be quite hard to see. When shedding is completed the goat is left with a very short fine coat of new hair which had started growing under the old winter coat. This new coat continues to grow all summer and fall until the full coat is attained again by late fall. The new coat appears surprisingly clean immediately after the loss of the dirty old one, but it soon yellows and remains quite yellow through the summer. Apparently snow in the fall and winter helps to clean it again.

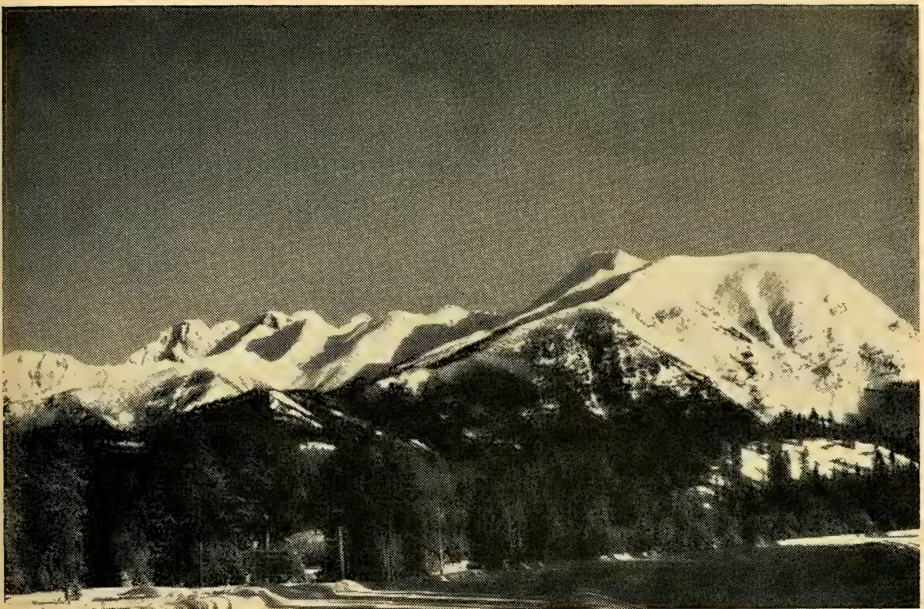

FIGURE 2. Mt. Wardle showing southern exposure of goat range.

Although goats are usually thought of as being all white, this is not always the case. Many young goats have some dark or black hair along the dorsal line of the tail and back, around the eyes and the hair line of the hooves. The dark hair in the tail is often noticeable enough to be seen from some distance. This dark hair seems to lessen with age and adult goats have little if any of it. Seton (1927) reported that many mountain goat hides at the American Museum of Natural History contained a number of coarse brown hairs along the back, rump and tail. Brandborg (1955) mentioned that a day old kid and a yearling in Idaho had dark hair along their backs and tails. Conversely, Casebeer *et al* (1950) stated that during a study of mountain goats in Montana, no such colouration was found.

Horns

It was possible to measure the horns of five goats from Mount Wardle. The horn of a male kid about 7 months old, which was killed in an avalanche in January, 1962, measured 2½ inches. Horns of a male kid about 6 months old, which I collected on November 21, 1963, measured 1⅝ inches. This kid had been sick for some time, which might have influenced horn growth. The horns of two billies which died after their fifth growing season were 8¼ and 9 inches long. A nanny horn of 9 growth seasons measured 9¼ inches. The last three measurements were of horns picked up on the range, causes of death were unknown. Ages were determined from annual growth rings on the horns, the nearest ring to the tip marking the end of the second growing season. There is no growth ring after the first growth season (Brandborg, 1955).

Deformities in horns were fairly common in the band. In some cases one shell was missing, in others the entire horn, both shell and core, had been broken off. In two of these cases the horn was of normal curvature with just the tip missing, but in one instance the broken horn had grown straight up from the head while its mate was curved normally. I observed this goat in the field on one occasion and found her head after she had died from unknown causes some time later. The normal horn was 9¼ inches long and the deformed horn was 6¼ inches. The core inside the deformed horn was almost perpendicular to the skull. It seems likely that the injury occurred at about the end of the first year and the resulting straight horn was grown thereafter. I also saw a live male goat with a similarly deformed horn.

Although goat horns are extremely sharp and make very formidable weapons, I have never seen goats actually fighting. In all seasons of the year I have seen goat threaten with their lowered horns and occasionally I have seen one goat pursue another with lowered head. Fights are probable and would likely result in fatal or near fatal wounds. On the other hand, their horns would seem to be an excellent defensive weapon to use against predators. Cahalane (1947) stated that goats have been known to kill black and grizzly bears by horn thrusts into the heart, lung or abdomen.

Hooves

The feet of the goat are particularly well adapted to their environment. The hoof is quite short and broad but also quite sharply pointed. The inner pad almost protrudes from the horny outer shell. This pad is of a tough rubbery material which affords excellent traction on steep rock while the outer shell is very hard and tough and will support the animal's weight even when standing on a very minute foothold, where only a small fraction of the hoof surface is bearing.

Voice

Young mountain goats have a very distinctive voice which they use a great deal. A young kid, separated from his mother by as little as eight or nine yards, will bleat almost continuously until reunited. This trait continues through the first year. Several times in the fall I have sat among widely scattered groups of as many as 40 or 50 goats and heard bleating among the kids almost continuously. I have often heard yearling goats bleat as well, sometimes when alarmed and other times for no apparent reason. In older goats the voice is rarely used. The call of the billy somewhat resembles that of a cow elk (*Cervus canadensis*) although more hoarse. On November 13, 1963, I heard two different billies bleat much the same as kids do, although with a much lower pitch. Both males were moving between groups at the time and it seems likely that this voice was associated with the rut, though more as a call than as a challenge. It has been described as a coarse grunt by Seton (1927). On three occasions I also heard females bleat with much the same sound as that made by male goats. On one of these occasions, in July 1963, I attributed the call of the goat to its having been startled by the observer. Two other times I have heard females bleat when separated from their young.

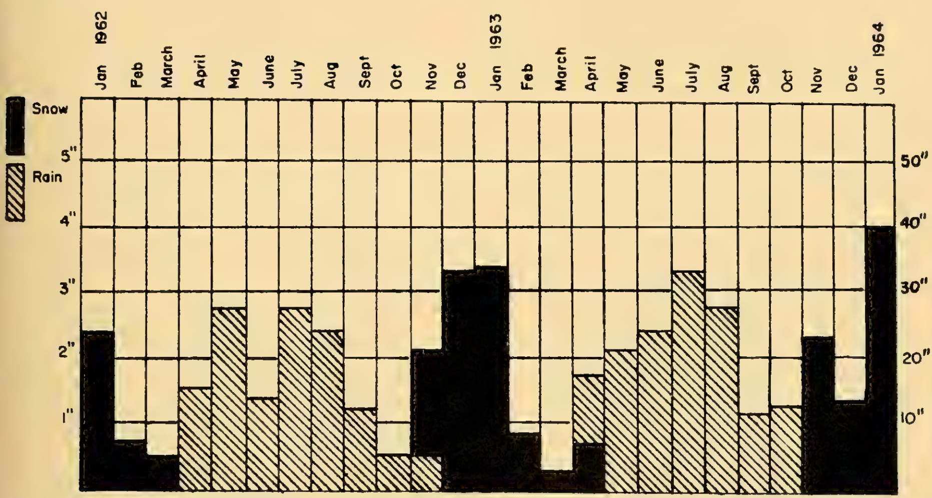

FIGURE 3. Weather records from Kootenay Crossing, five miles south of the study area, January 1962 to January 1964.

This vocalization was accompanied by lifted head and searching looks. In one of those instances the kid, which was a few days old at most, was lying down in the shelter of a rock overhang; the mother walked a few steps until able to see it and then returned to her feeding.

SENSES

Eyesight

The eyesight of goats seems to be very acute, probably comparable to that of bighorn sheep (*Ovis canadensis*). Like many mammals they detect moving objects much more readily than motionless ones. I have been able to stalk goats in the open quite closely as long as I remained motionless when the animal was looking in my direction. However, they would detect very slight movement from some distance. This characteristic was reported by Casebeer *et al* (1950) and Brandborg (1955). Like bighorn sheep, goats seem to have a very wide angle of vision. Even when facing at a 90 degree angle from the stalker, they are able to detect slight movement.

Hearing

Although the hearing of goats is good, it does not seem to be as highly developed as their eyesight. I have tested them with progressively louder noises and noted that they reacted only after the noise became comparatively loud. Movement of rock and shale does not unduly disturb them probably because they themselves are constantly dislodging rocks.

Smell

The sense of smell is well developed in mountain goats but in this band, which enjoys a large measure of protection from hunters, they usually confirm their suspicions by eyesight. Often a goat which had not seen me would approach upwind toward me until able to confirm what its sense of smell had told it. Smell seems to play a large part in mating activity. All advances by the male are accompanied by smelling of the female.

LIFE HISTORY OBSERVATIONS

Mating

Mating in this band of goats takes place in November. In 1963 I observed actual mating on November 13, 14, 20 and 24. Although I watched for some time each day after that, I saw no more rutting activity with the exception of the odd mature male wandering from group to group. After November 28 mature billies isolated themselves from the females and younger goats. In most cases they went slightly higher and farther west on the range than the rest of the band. They were observed singly and in pairs but rarely with more than two in a group through the following winter.

Male goats do not herd a band of females together as do elk. Rather, the females go their various ways and the billies roam from one group to another, looking for receptive females. As in most ungulates, the male goat seems to be able to tell when the female is approaching oestrus. Upon finding a nanny in this stage the billy will stay with her constantly, often attempting

to breed before she is ready. At times the nanny will avoid the male by running, only to be followed closely. At other times the female will lie down to avoid the billy, only to be prodded to her feet eventually. Another approaching billy is ignored until he comes within 25 or 30 feet. The defending male then threatens the intruder by strutting toward him with arched neck and lowered horns. In all such cases I witnessed, the intruder made a hasty retreat. The male continues to court the female with much rubbing, licking, nuzzling and smelling. Eventually the nanny reaches her receptive period and mating takes place. One nanny I observed was bred by the same male five times in less than an hour. The female lay down only to be prodded and nuzzled by the billy until she got to her feet again. She would no longer stand for the male after that, and moved away with each additional attempt he made to force his attentions on her.

During the rut mature billies often wallow in dirt. The male goat will sit on his rump, braced upright with one front foot, and paw dirt all over his underside and hind quarters. This behaviour is usually accompanied by frequent urination, with the result that the billies become much dirtier than the females and younger goats and are easy to distinguish at a distance.

Several times during the rut I saw five or six month old kids mounting others of the same age. This does not mean that mating took place, but may be an indication that the rutting urge starts quite early. More probably it is merely play. In no instance did I see a mature male show any interest in a yearling female, even when in the same group with one. Young billies of a year and a half, or two and a half, definitely show sexual interest during the rut although they were less aggressive than older males. They were often seen near an older goat which had possession of a female in heat. They did not paw the dirt and strut with arched neck in an obviously masculine way as did the older billies. I did not see any yearling or two-year-old males mounting females. I doubt that they participate in mating except in isolated cases where no older male is present. Mature males, if unattached, keep up a constant patrol of all goats on the nearby range and are aware of any female approaching oestrus, long before she is receptive. Evidence collected by Lentfer (1955) in the Crazy Mountains in Montana indicated that first breeding in females occurred at approximately two and a half years.

One incident recorded on November 22, 1963, illustrates the mating season behaviour of goats very well. A very large male was travelling in a southerly direction along the mountainside. Moving in the opposite direction on a converging course was a group consisting of two nannies, two kids and one young billy. Eventually the large billy met the group. The billy, visibly alert, ran over to the first nanny, smelled her genital region, ran to the second, smelled her similarily and then continued on his way south without so much as a backward glance. The young billy and the two kids moved off the trail as the old male went past.

On another occasion I made a lengthy observation of a young female, of two years plus, and a mature male. The nanny was in heat and, after some time, copulation occurred once. The male was distracted a great deal by another younger mature male and frequently rushed at him to chase him away.

The young male would flee and then immediately follow the older goat back again. In one instance the older goat chased him at a fast run for about 70 yards, only to be followed back to the female again. The younger male made no pretense of fighting. After an hour or more the female moved about 30 yards away from the old billy and the younger male immediately took possession of her, only to be chased away again before making any conquest. The nanny appeared to be equally content to be accompanied by either male.

Birth

Virtually all females bear their kids in the same area on this range. Fortunately for observation purposes, much of the kidding area can be observed from the highway with binoculars. The kidding area is very rough, with cliffs and ledges occasionally broken by gullies and benches.

Each nanny chose a high and inaccessible shelf, usually on a cliff face, and remained there until after her delivery. Most of the females isolated themselves not more than 24 hours before the birth of their young.

Although long since weaned, the yearling kids followed the nannies right up to within a very few days of the birth of the new kid. At this time they were driven off by their mothers and they formed temporary yearling groups. These groups of yearlings seemed particularly active, as though they had been liberated from strict discipline. They raced around quite precipitous cliffs with more careless abandon than I had seen in any other age group of goats at any other time.

The earliest date of parturition I have recorded on this range was May 24, 1963, and the latest date was June 3 in 1962. The arrival of the new crop of young takes place in a surprisingly short period of time. In 1962 all the kids appeared to be born within four days, so in 1963 I tried to confirm this by spending time watching each individual goat. In 1962 the first birth was observed on May 29 and in 1963 the first kid arrived on May 24, five days earlier than the previous year. By May 27, 1963, I was able to count 18 newborn kids and, although I watched carefully, I saw no new births after that and was never able to count more than 18 kids on the range through the following summer.

Among the 18 kids born in 1963, I felt positive in the identification of at least two sets of twins. Both the nannies involved gave birth on isolated ledges, quite remote from other goats. In both instances, I observed the nannies before and after parturition. They were isolated from the rest of the goats in the area nearly 24 hours before giving birth and remained isolated until the day following the birth of their twins. Both were seen carefully leading their young over very rough terrain, before being joined by other goats.

In 1962 I observed at very close range, one set of twins at an age of only a few hours. The nanny was still quite wet and disheveled from the delivery and the kids showed signs of having dried off only recently. The fact that the female allowed both kids to nurse appears to confirm their authenticity as twins. The following day they were still in about the same place and were still isolated from the rest of the herd.

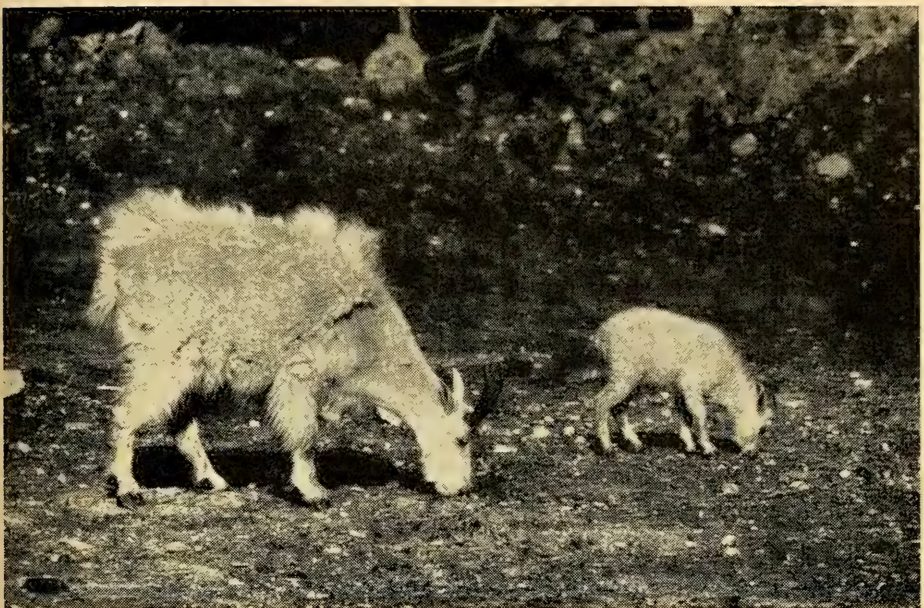

FIGURE 4. Nanny with young kid, taken in late June. Head and neck are shed of winter hair while rest of winter coat remains.

By using November 19 as an average breeding date (midway between the earliest – November 13, and the latest – November 24 – mating activity seen) and May 29 as an average kidding time (midway between May 24 – the earliest, and June 3 – the latest date of parturition seen) I have tentatively determined a gestation period of 191 days. This is almost two weeks longer than the 178 days reported by Seton (1927) and much longer than the 147 days reported by Keneth (*in* Rand, 1948). I believe the 191 day gestation period is probably accurate within a week in either direction for goats in this area.

Young

Very young goats closely resemble the young of bighorn sheep. Their coat is white but their size and appearance are similar. By the time the young goats are five or six weeks old, this resemblance has been lost and they begin to look like the adult goat.

Kids begin to make use of grass and browse soon after birth. It was not unusual to see kids two or three days old nibbling the same bush as their mothers. Brandborg (1955) also noted that kids took forage.

The first few days after their kids are born, the mothers remained constantly within a few feet of them. I never saw a mother goat go away and leave her young hidden during their first days of life as cow elk or doe mule deer (*Odocoileus hemionus*) will do. This agrees with observations of Casebeer *et al* (1950). When the nanny is feeding, her kid is immediately by her side or bedded within a few feet of her. Within two weeks, however,

the young are able to follow their mothers almost anywhere. The mothers remain quite attentive but no longer shepherd them quite so closely.

After a few days of isolation after parturition, sometimes only one or two, nannies were often rejoined by yearlings. These yearlings had lost their status as kids and were kept at a distance from the newborn young by the mother. On May 27, 1963, I observed a mother with a newborn kid followed by four yearlings. This was an extreme case, but I have often seen nannies followed by one or two yearlings, only two or three days after the birth of the new kid. Perhaps after a few days of being on their own the yearlings feel a need of being accepted back into the family. They are tolerated by the nanny but are treated no differently than any other intruder if the welfare of the newborn kid is threatened in any way.

Ability to travel in very precipitous and rugged country is not manifested immediately after birth in kids but is inborn to the extent that it can be learned very early. On May 29, 1962, I was able to approach very close to a nanny which had recently given birth to twins (mentioned previously in the section on birth). On my approach the nanny tried in vain to lead her young from their place of birth on a narrow rock shelf. The twins were quite able to walk but were unable to negotiate a step in the rock only 12 or 14 inches high. The mother finally climbed down to a spot below the twins and, while attempting to follow her, they fell and rolled a distance of 30 feet or more. Upon landing on a scree slope, both twins promptly got up and followed their mother along a fairly flat ledge and then back onto the scree and around a corner. Neither goat appeared harmed by the fall. The next day they were back on a continuation of the same ledge.

On May 27, 1963, I watched a mother goat which appeared to be teaching her single kid to climb and travel in precipitous terrain. Several times the nanny mounted a large rock and then jumped to another across a gap of about four feet. After each time the nanny did this, the kid would climb up and repeat the same jump, although much more awkwardly. This kid was not more than three days old since I observed the arrival of the first kids that spring on May 24.

BEHAVIOUR AND ACTIVITIES

Seasonal range use

Different parts of the range were utilized in different seasons. In winter goats were on lower extremities of range and confined largely to the southern end of it. During that time they were seldom above 5500 feet and their movement was quite restricted. A small group of goats may not move more than two or three hundred yards in a week. That remains the case well into May. With the approach of kidding time they sought slightly higher areas in the broken rugged part of the range on the east and north-east slopes. After kidding they gradually dispersed higher and farther afield until in mid-summer they were often found on the very top of the mountain and several miles both north and north-west of their winter range. They kept mainly to this high country until well into the fall when permanent snow arrived at the high

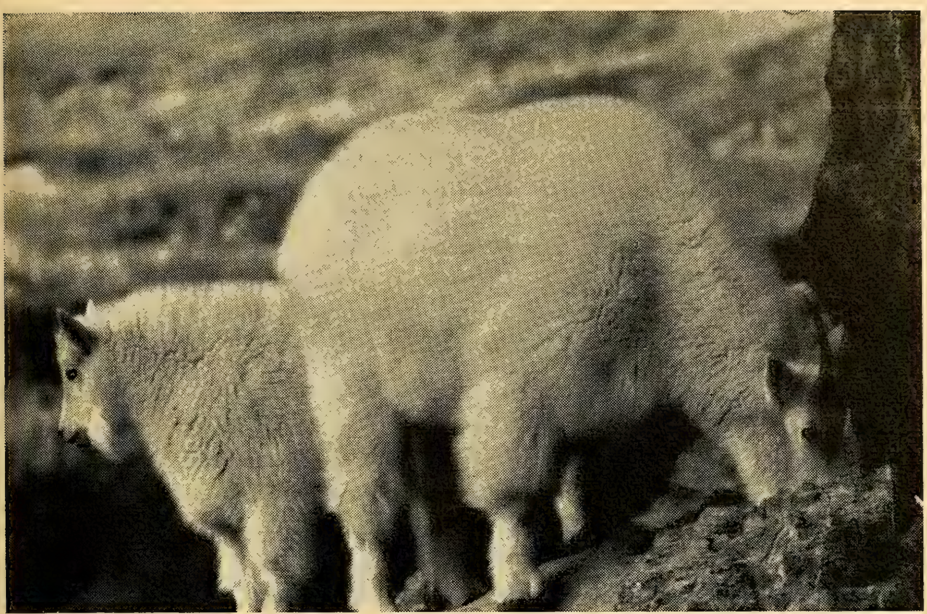

FIGURE 5. Nanny with five month old kid in October, showing heavy winter coat almost completely grown in.

elevations. As the snow line on the range gradually moves lower in the fall, the goats would move down with it until in late November or early December they would arrive back on their winter range at the lower levels.

From observations of feeding goats, it appears that the winter food is largely of browse while most of the summer forage is grasses and grasslike plants. Red ossier dogwood (*Cornus stolonifera*) was very heavily browsed in winter on the lower slopes while willow (*Salix petrophilia*), Douglas fir, aspen and buffalo berry (*Shepherdia canadensis*) were also utilized.

Availability of water on this range is little problem. Wind in the winter deposits huge snow banks and cornices which may last most of the summer, and there are a few seepage springs at high elevations. In the past two summers I have not known these goats to be forced to lower range because of lack of water.

Travel

I noticed that when kids are very young their mothers travel constantly below and beside them as if to protect them from a fall. By the time the kids were a week or ten days old, however, they could be seen trailing along close behind their mothers. Goats cannot climb where a man cannot go but in many cases it would take a competent climber to follow one. They appear to have the advantage of being absolutely unafraid of any height. Under normal travel conditions they are very deliberate about how and where they go. In

TABLE 2.—Sizes of mountain goat groups observed on Mt. Wardle

Group Size	Number of Observations	% of Total Observations
1	7	10.3
2	17	25.0
3	8	11.8
4	8	11.8
5	7	10.3
6	5	7.4
7	3	4.4
8 to 10	2	2.9
11 to 15	4	5.9
16 to 20	2	2.9
21 to 25	2	2.9
26 to 30	2	2.9
31 to 35	1	1.5

steep rock each step is carefully chosen and often they will retrace their steps and choose a new route rather than attempt a difficult place. However, I have seen them jump and bound when momentum was required to carry them from one secure spot to another some distance away, both in a traverse as well as climbing or descending. In a traverse they often bound and land once on a cliff face where they would be unable to stand, then immediately bound again, landing on safer footing the next time. This same method is employed when climbing up or down, with variations to suit the terrain. On narrow ledges goats often rub hair from their sides by crowding close to the face of the cliff.

In spite of their remarkable ability there are many places where a goat cannot go. Ordinarily they would not attempt to go in such places but under stress they sometimes try to climb beyond their abilities. On two occasions, upon surprising goats at very close range, I saw this demonstrated. In the first instance the goat attempted twice to climb an almost vertical cliff about 30 feet high with very little in the way of footholds. He fell and rolled down twice before giving up the attempt and running close by me to make his escape. In the other instance the billy was able to attain a stand about 12 feet above me but was unable to go higher. He remained in this position for several minutes, watching me until I moved off a short distance, allowing him to jump back down and move away on another route.

On one occasion I was watching and photographing a small group of goats at a lick. One goat was standing in the sun on the very brink of a cliff some 30 or more feet high. Suddenly the rotten rock on which he was standing gave away and he almost fell over the cliff. With much scrambling with his front feet he was able to save himself. This incident did not seem to frighten the goat. He simply went back to sunning himself in the same manner, still standing on the very brink of the cliff. Although goats seem to avoid snow as much as possible, it appears to impede their travel very little. Where possible they keep to the barest ground, but upon being confronted with a snow filled gully they do not hesitate to cross. I saw goats sink almost

TABLE 3.—Seasonal changes in grouping of mountain goats based on observations of 68 groups

Month	Mean Group Size	Number of Groups Seen
January	6.05	17
February	6.55	9
April	14.00	1
May	3.25	20
July	20.00	5
November	5.31	16

to their backs while moving across a soft snow cushion on a lee slope. The presence of snow on steep rock, which would make travel very difficult for a man, troubles a goat very little.

Travel for the most part seems slow and deliberate, often even when slightly alarmed. This can be very deceiving however, as a travelling goat can cover a surprising distance in a short time. They can gain 1500 feet in altitude on a mountain in about 20 minutes with little apparent effort. The same climb made by a good mountain walker would likely take an hour to an hour and a half.

Grouping

The frequency of observations of different sizes of groups is tabulated in Table 2. The average group size was 6.3 goats. Table 3 has been compiled to illustrate difference in size of groups in different seasons.

Grouping lacked cohesion with the exception of family groups consisting of nannies, kids, and perhaps, in summer months, yearlings. Largest groups observed were usually concentrated at licks in summer or during inclement weather in winter when on bedding grounds. This type of aggregation results from numerous single goats and small groups congregating on a common bedding area where shelter is the best available. This then is a common response to environmental conditions rather than an indication of gregariousness. There was a marked trend to larger groups in the summer months when females, kids, and immature goats grouped loosely together. These groups also lacked cohesion and changed from day to day and even from hour to hour in composition. Mature males were less social than other segments of the population. During most of the year they spent their time alone or in the company of another male. This is the usual situation but there are exceptions, as when an old male accompanies females and younger goats. In general there appeared to be a considerable amount of variability in sex and age composition of goat groups throughout the year.

Use of licks

The main season that goats visited licks was during May, June and July, with occasional visits at any other season. In spring and early summer they would often come in fairly large groups and sometimes spent hours on the

lick. One natural lick, or perhaps better called semi-natural, within one hundred yards of the Banff-Windermere Highway, is actually a quarry where rock has been taken for fill and construction for several years. Goats often stood on the face of this quarry and licked the exposed limestone for hours at a time, frequently watering at a small stream that runs through the bottom of the quarry. Another semi-natural lick, approximately half a mile south, is above the highway where a cut has been made and limestone exposed. Goats travelled through thick timber for about half a mile to reach this lick. It was used less frequently than the other. Cowan and Brink (1949) mentioned that goats travelled through miles of forest to reach natural licks in Jasper National Park.

Goats frequently came down two or three thousand feet to lick a block of stock salt which I put out. Even months after the salt was completely gone they licked the ground and rock where it had been.

Association with other species

Goats on Mt. Wardle are for the most part isolated from other ungulates. In the summer of 1963 two mountain sheep were on the higher part of the range for a few weeks but left the area by crossing the Vermilion River to the opposite watershed and did not return. There is a slight overlapping of elk and goat range in the late fall and winter. During both the winters of 1962 and 1963, there were up to a dozen elk on the gentler and lower southern slopes of the range. Although I have seen elk and goats feeding quite close together, there seemed to be no intolerance of one another. Elk, deer, and an occasional moose (*Alces americana*) sometimes frequented the goat licks in the spring and summer but at no time did I see two species together on these licks. Warden Coggins, of Banff National Park, reported that in June 1961 he saw goats mixed with both elk and sheep at a lick at Flints Park in the Cascade River drainage. I have often seen goats and sheep feeding in close association on the Palliser Range in the Cascade River drainage of Banff National Park. There seemed to be no intolerance or attraction between the two species in these instances. Usually the goats kept to the rougher more broken areas while the sheep kept to the better grassed areas. Casebeer *et al* (1950) reported that elk dominated goats at a lick and would drive them away while goats were dominant over deer at a lick.

Reaction to man

Reaction to man by this band of goats varied according to season, size of group, and circumstances under which they were encountered. At low elevation licks I often approached to within a few feet of goats without alarming them to any extent. On the other hand, I found them hard to get close to at high elevations. The months of March and April were the best times in which to approach closely, perhaps due to the poor condition of the goats at this time. The larger the group the less likely it was that they would allow me to get near them. When one animal fled in fright the others almost always followed. Goats of one or two years of age were usually the first

to show alarm. When alarmed or suspicious of something, goats invariably carried their very short tail erect. This was sometimes accompanied, in younger goats, by a sharp bleat.

When approached goats usually showed little or no animosity toward the observer. When newborn young are present this attitude sometimes differed. A nanny with newborn twins, which I approached quite closely, made it very obvious that it would be unwise to come any nearer her young. While trying to get her kids to follow her she made several abortive charges in my direction, stamped her front feet, and shook her head in anger. I was on a ledge a few feet above the goat and her young. Had I been between them, I'm sure by her actions that she would have attacked me.

One other incident of intolerance occurred on May 21, 1963, when I approached to within six feet of a large male. He was below me and when I came very near he faced me, stamped his front feet, pawed the ground, and arched his neck. He refused to be chased from his location.

If I encountered goats at close range and remained motionless, curiosity often caused them to come much nearer. Casebeer *et al* (1950) also observed this behaviour in goats.

The fact that this group of goats range most of the time in Kootenay National Park where hunting is prohibited may have an influence on their reaction to man.

Posture and bedding

Goats are the only ungulates I have seen that will remain for a period of time in a sitting position on their rumps, braced up with their front feet. Another apparently exclusive trait is their habit of lying down with their front legs extended in front of them rather than tucked under as most hooved animals lie. This is not the rule but it is quite commonly observed. While lying in this position they are capable of throwing dirt over their backs with a peculiar lateral motion of the foreleg.

During fine weather goats, like mountain sheep, picked bedding sites from which they could command a good view and often could not be seen very easily themselves. They pawed out small flat places and laid facing down hill with their backs to the mountain. During hot weather a snow bank was often used for bedding. In inclement weather they often sought shelter under overhangs or in shallow caves, behind trees, or anywhere that offered more protection than the exposed slopes. Many of these bedding places were used over and over until manure was built up to a depth of several inches. When small, kids often lay on the uphill side of their mothers, making it difficult to see them except from above.

MORTALITY FACTORS

Accidents

Probably the most frequently fatal natural hazard, aside from a hard winter, is an avalanche. The east and north-east face of Mt. Wardle is of sufficient steepness that, although snowfall is not heavy, avalanches occur frequently.

Ordinarily these slides are not large but they usually originate very high where wind cushion and cornice have added to the natural snowfall. By the time they have reached the lower elevations where goats are wintering, they are travelling very fast and a comparatively small avalanche is sufficient to overcome any goat in its path. On one occasion I found two goats, a young rising yearling male, and an older goat, probably his mother, melting out of a slide in April. They apparently were killed in a slide which occurred about January 8, 1962. In other instances I have found bits of hide and hair in avalanche areas, but, as those slide paths are regularly patrolled in the spring by scavengers such as coyotes and lynx, carcasses are not often found intact. I was often amazed at the lack of caution of goats in avalanche areas in winter. Often they waded across deep coulees which were filled with soft snow which was ready to slide at any time. It is possible that goats may trigger slides themselves. The fact that they are seldom closely bunched would probably result in only one or two being taken by a single slide rather than larger numbers. Warden Laurilla of Glacier National Park mentioned, in a game observation report, that on April 1, 1962, he found a female goat killed in an avalanche near the Trans-Canada Highway. Brandborg (1955) cited two instances of goats being caught in avalanches.

Although I have not seen goats injured or killed in a fall, I am convinced this sometimes happens. I have seen goats lose footing and fall without mishap under circumstances where, had they been higher on the cliff face, they most certainly would have been injured or killed. From watching young kids fall, I believe that it is possible for a goat to survive a fall that would prove disastrous for a human, simply because they are able to land in a relaxed state, rather than stiffened up with fright as a person would be.

Goats seem to view falling and rolling rock with little concern and take no pains whatsoever to avoid it in their travels. On several occasions, when climbing below them, I have had rocks roll past me quite closely. The law of averages would seem to make this somewhat of a hazard, probably occasionally resulting in a fatality or injury. Goats took alarm if a rock or land slide was extensive but their flight seemed in no way planned. They simply moved off to left or right and were about as likely to run into the path of the slide as away from it.

Fighting

I have seen no instances of goats being injured while fighting but this no doubt occurs. Seton (1927) cited a fight between two males in which fatal injuries occurred. Brandborg (1955) described a fight between two males in which he thought injury might well have been inflicted.

Weather

The most telling hazards goats face are severe winter weather and depletion of available range, the first often contributing to the second by covering forage. Of the two years I have observed this band, the winters would be classed as easy or good, with less than average snowfall and little extremely

cold weather. Although there seemed to be no deaths due to starvation in these winters, all the goats were extremely thin in the spring. This would indicate that the dividing line between high survival and high mortality could be very thin. In March of 1962 I followed a two or three year old billy which was in such poor condition that he would get up from his bed, move about 50 yards and then lie down. When I moved closer again, he would get to his feet, move off a short distance, and lie down. Had I continued to follow him, I am sure I could have exhausted him within an hour or two. This age group and the very old seem to take winter the hardest. Kids seem to winter on this range better than any other age group. This is contrary to the findings of Casebeer *et al* in Montana (1950) as well as Brandborg (1955) in Idaho. The rising yearling, in the springs of 1962 and 1963, were certainly in far better shape (based on appearance and activity) than other age groups. Their coats remained cleaner and sleeker, their travel more spirited, and bodies better fleshed than older age groups. I have found that viewing goats from the rear is the best way to determine fleshing. Seen from the rear a very thin goat appears almost unbelievably narrow, while the same goat viewed from the side appears in fair condition because of the ample coat it carries. Yearlings on this range shed earlier than other age groups. In livestock this is considered an indication of good health and physical condition.

Cold and snow are not the only winter hazards in the Mt. Wardle area. Frequently there are rains of short duration at unexpected times in the winter and, when followed by sharp frost, they make forage more inaccessible by icing it in. At these times the band reverts entirely to a browse diet.

In the past two years winter losses in this band have been very light and, consequently, there has been a sharp increase in numbers. However, one severe winter could eliminate this gain, or perhaps even reverse the trend. At any rate, these goats winter under such adverse circumstances that surviving stock almost certainly must be very hardy and weaklings non-existent.

Disease

In the two year period during which I observed this band of goats, disease did not appear to be a factor influencing their survival. Only one animal visibly affected by disease was seen. On November 21, 1963, I collected a male kid of about six months of age which was in very poor condition and was barely able to travel. His mouth was badly abscessed around both upper and lower jaws with some flesh so badly swollen and rotted that pieces were sloughing away. The kid would probably have died within a few days. The animal was taken to the Health of Animals Research Institute at Lethbridge, Alberta. The report received from them read as follows: "Bacteriologic examination of the purulent material revealed the presence of hemolytic coagulese – positive staphylococcus. This organism is pathogenic and capable of producing fatal abscesses. However, from epidemiological point of view, it is not contagious: infection occurs by direct contact and wound contamination".* This kid was in poor physical condition due to its affliction and

*Canada Department of Agriculture, Animal Pathology Division, Health of Animals Branch. Report on Specimen No. 63W8, November 29th, 1963, from Animal Diseases Research Institute (Western), Box 640, Lethbridge, Alberta.

weighed only 33 pounds. Healthy weight probably would have been at least 40 pounds.

Rocky Mountain ticks (*Dermacentor andersoni*) are quite common on this range and goats become infested with them in the spring. I have not seen any goats whose excessively poor condition I would attribute to ticks. No specimens have been examined for internal parasites.

Peritonitis would likely be a complication of horn wounds. Cowan (1944) cited one case where the peritoneum was ruptured from a horn wound in a specimen taken in Banff National Park. In that case the intestine had not been punctured.

Although there has been no marked mortality due to parasites or diseases in the past two years, these could easily become a controlling factor under prolonged periods of severe winter conditions.

Predation

Although grizzly bears, cougars, lynx, and coyotes occasionally frequent this range, I have found little sign of predation on goats. In two instances I found what could have been cougar kills but all that was left was hair and wool and I was unable to determine the cause of death precisely. This range has much good escape terrain which gives a large measure of protection from these species. Wardens McPhee and Tasker of Banff National Park witnessed an unsuccessful attempt by a grizzly bear to kill a goat in Banff Park. Frank Goble of Waterton, Alberta, told me that, while hunting west of Waterton Lakes National Park, he witnessed a cougar spring upon and kill a goat. In this case the cougar was on a cliff above the goat, blocking the way to his escape terrain. The goat kept trying to make his way up into the cliffs until, upon coming too close to the cougar, he was sprung upon and killed.

There are reports in literature of eagles preying on young goats but I have not seen this happen, although there are both bald and golden eagles in the area. On another range a few miles away I watched an adult goat being chased by three eagles. The eagles were circling and diving on the goat as he ran at full speed along a ridge of the continental divide. The goat seemed in great distress but, as both goat and eagles dropped from view over the far side of the ridge, I was unable to see the outcome. This goat was alone while being harassed by the eagles but a few hundred yards farther along the ridge there were four other goats, all of which moved quickly out of sight as the running goat and eagles approached. I was unable to identify which species of eagle these were because of the distance. Brandborg (1955) mentioned similar cases of eagles harassing goats and Casebeer *et al.* (1950) cite cases of eagles carrying off very young kids.

FUTURE PROSPECTS

Prospects for goats on this range, as well as for goats on the whole, seem bright. Although they live under more severe conditions than any other ungulate in western Canada, they have not been driven onto their present ranges by the encroachment of civilization. They still occupy approximately

the same areas they did at the time of the coming of the first white men to the west. Their food habits are such that they can survive on a very diversified diet if necessary. Their habitat is rugged enough to discourage a large percentage of hunters as well as many predators. Their horns, while not impressive enough to be highly coveted as a trophy, are more lethal as a weapon of defence than those of many mammals.

The isolated status of many bands serves to protect them from diseases contracted by other bands, as well as other species. Their habitat, in most cases, is rugged enough to isolate them from domestic livestock. The greatest key to survival is probably the fact that their range is of little value to civilization for any other use than that for which it is being used now — a mountain wilderness. For this reason more than any other, I think they will survive in the future.

SUMMARY

Observations were carried out on the behaviour and life history of a band of Rocky Mountain goats on Mt. Wardle, Kootenay National Park, British Columbia, from January 1962 to February 1964.

Movement of the band was influenced mainly by the seasons and goats ranged from the lowest part of the range at 4,000 feet to the top of the mountain at 9,200 feet. Lower extremities were used in winter and spring and higher elevations were used in summer and fall.

During the study period, mortality rate was low among goats in their first year of life. The population of goats in the study area increased considerably during the period of study, probably due to fairly easy winters.

Rutting in the band commenced before mid-November and was over before the end of November. Yearling females were not observed to take part in the rut. Breeding activity was dominated by males over three years of age.

Parturition was noted as early as May 24 and as late as June 3 during the two kidding seasons. Parturition in the band takes place during a very short period of time. The gestation period was calculated to be approximately 191 days.

Licks were frequently used in the spring and summer. Little competition was observed with other species at any time.

There was little indication of mortality due to predation, disease, or parasitic infestation during the study period. It was found that avalanches frequently killed goats.

Reaction to man varied with the season, condition, and location.

Average group size was 6.3 goats, and largest groups were observed at licks in the summer and on bedding grounds during severe weather in the winter. The month of highest gregariousness was July, while smallest groups were observed during kidding time in May.

Kids followed their mothers almost to parturition, were then driven off by the nanny, only to rejoin the females and new kids a few days later. These yearlings, upon rejoining the mothers and new young, had lost their status as kids and were kept at a distance by the mothers.

Future prospects for the goat population seem good.

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REFERENCES

BRANDBORG, STEWART M. 1955. Life History and Management of the Mountain Goat in Idaho. State of Idaho, Department of Fish and Game, Wildlife Bulletin No. 2, 142 pp.

CAHALANE, VICTOR H. 1947. Mammals of North America. Macmillan, New York, 682 pp.

CASEBEER, R. L., M. J. ROGNRUD, and S. M. BRANDBORG. 1950. Rocky Mountain Goats in Montana. Montana Fish and Game Commission, Bulletin No. 5, 107 pp.

COWAN, IAN MCT. 1944. Report on Wildlife Studies in Jasper, Banff and Yoho National Parks, 1944 and Parasites, Diseases and Injuries of Game Animals in the Rocky Mountain National Parks 1942-1944. Ottawa. 147 pp. (mimeographed).

LENTFER, JACK W. 1955. A Two Year Study of Rocky Mountain Goats in the Crazy Mountains of Montana. Journal of Wildlife Management, 19 (4): 417-429.

RAND, A. L. 1948. Mammals of the Eastern Rockies and Western Plains of Canada. National Museum of Canada, Bulletin No. 108, 237 pp.

SETON, ERNEST THOMPSON. 1927. Lives of Game Animals. Doubleday, Page and Co., New York, Vol. III, 780 pp.

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FOOD HABITS OF THE ASHNOLA BIGHORN SHEEP HERD*

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There have been alarming declines in the numbers of California bighorn sheep, *Ovis canadensis californiana*, in the Similkameen region of British Columbia since the late nineteenth century. Present conflict with domestic stock for a limited food supply makes further herd reduction imminent. In May, 1960 a two-year study of the Ashnola bighorn herd was initiated under sponsorship of the University of British Columbia and the British Columbia Fish and Game Branch (Blood 1961). That study was broad in scope and designed to provide a background for future more intensive investigations. Major objectives were merely to gather sound range and population data on which to base management and conservation practices for the herd.

The purpose of this paper is to present a brief account of food-habits observations made during the study. Although the data are not extensive they were carefully obtained and appear to be worthy of reporting because little information is available concerning the foods of California bighorn sheep. Other aspects of the ecology of this bighorn herd have been reported elsewhere (Blood 1963a, 1963b).

The principal study area is immediately adjacent to the 49th parallel of latitude, and is bounded to the west, north, and east by the Similkameen River. The intensive part of the investigation took place on the South Slope winter range, (Figure 1), along the lower reaches of the Ashnola River, about 10 miles south of its confluence with the Similkameen. The herd consisted of 250 to 300 sheep in 1962 and its maximum range was about 200 square miles. During mid-winter the majority of the herd may be concentrated on less than five square miles of key winter range. A brief description of the study area in terms of altitudinal vegetation zones was given by Blood (1961). Major attention in this paper will be given to the edaphic climax grasslands which are important as winter range (Figure 1).

Methods

Botanical composition of key winter ranges was determined by the line-point sampling method as described by Dasmann (1951). The points were located on temporary 500-foot straight line transects using a fifty-foot steel tape. The plant species occurring either directly over or under each of the foot marks along the extended tape were then recorded. The tape was moved ten times to complete the 500 points at any particular site.

Feeding habits were determined by inspection of grazed areas after sheep use, and by analysis of six rumen samples. In December, 1960, after a fresh

*Contribution from the Department of Zoology, University of British Columbia, Vancouver, B.C.

TABLE 1.—Fall-Winter-Spring food habits of the Ashnola bighorn herd.

Food item	Percent Occurrence in Diet as Determined by Various Techniques*				
	1	2	3	4	Mean
Bluebunch wheat grass *Agropyron spicatum*	49	23	47		
Bluegrasses *Poa secunda* and *P. pratensis*	4	12	16		
Junegrass *Koeleria cristata*	7	2	18		
Downy brome *Bromus tectorum*	tr.**	1	13		
Idaho fescue *Festuca idahoensis*	4	–	tr.		
Bent grass *Agrostis* sp.	–	4	–		
Columbia needle grass *Stipa columbiana*	–	2	tr.		
Richardson needle grass *Stipa Richardsoni*	tr.	–	–		
Total grass	64	44	94	85	72
Silky lupine *Lupinus sericeus*	3	5	–	2	
Yarrow *Achillea millefolium*	1	2	2	tr.	
Fleabanes *Erigeron* spp.	–	–	–	tr.	
Scorpion weed *Phacelia* sp.	–	–	tr.	–	
Nodding onion *Allium cernuum*	–	–	tr.	–	
Total forbs	4	7	3	2	4
Pasture sage *Artemisia frigida*	28	43	1	8	
Umbrella plant *Eriogonum heracleoides*	4	4	1	4	
Squaw current *Ribes cereum*	–	tr.	1	tr.	
Linear-leaved sage *Artemisia dracunculoides*	–	tr.	–	–	
Rose *Rosa* sp.	–	tr.	–	–	
Willows *Salix* spp.	–	–	–	tr.	
Lodgepole pine *Pinus contorta*	–	–	–	tr.	
Bearberry *Arctostaphylos uva-ursi*	–	–	–	tr.	
Grouseberry *Vaccinium scoparium*	–	–	–	tr.	
Total browse	32	49	3	13	24

*1. Winter grazed stem counts.
2. Trailing sheep in snow.
3. Spring grazed stem counts.
4. Six spring and fall rumen samples
**trace — denotes less than 0.5% occurrence

FIGURE 1. View of South Slope winter range, the key winter bighorn range of the Ashnola watershed. The area pictured rises from 4,000 to 6,200 feet in elevation.

snowfall, sheep were followed on the South Slope range and forage species utilized by them were recorded where the sheep had pawed through the snow and fed. A utilized plant was recorded as one feeding observation.

To obtain a general picture of over-winter food habits, grazed stems of plant species eaten were tallied in 30 representative one-square-meter plots in early May, 1961. That analysis was entirely limited to forage which had matured the previous summer, and had been utilized between late October, when the sheep returned from the summer range, and the end of April. Sites were selected in areas fairly heavily utilized by sheep, and actual placement of each plot was at a place considered to be representative of species composition in the area. Sight observations indicated that few mule deer (*Odocoileus hemionus*) made winter use of the steep open slopes preferred by sheep.

To determine foods eaten in spring after new growth was well underway, grazed stem counts were made in 20 one-square-meter plots in June 1961. That analysis was in the vicinity of the area studied to determine winter food habits, and at about the same elevation (4,500–5,000 ft). At this time most ram groups had left the winter range, but most ewe-lamb groups were still present. Thus the spring data apply primarily to the latter group. Only the growth of the year was considered in those plots.

Six one-pint samples of rumen contents were obtained from sheep between May 1960 and May 1961. Only the plant material which remained on a number ten screen after moderate washing under a tap was used for quantitative analysis. Relative composition was determined by separating the material by species and measuring the volume of wet plant material in a graduated cylinder..

It can be seen at once that the food habits data suffer from several limitations. Several techniques have been used and are not likely directly comparable. The grazed stem technique does not take into account the varying amounts of leafage produced by different species. The number of rumen samples is small. Nevertheless it is felt that some valid generalizations can be made and that the data may serve to indicate the relative importance of major bighorn food plants in this area.

RELATIVE SPECIES ABUNDANCE

Food habits data assume their greatest significance when considered in terms of the species which are available for grazing, and their relative abundance.

The grassland winter ranges in the Ashnola area belong to the bunchgrass type of the Pacific Northwest. Both the wheatgrass–bluegrass, and wheatgrass–fescue associations of Tisdale (1947) can be recognized. The former gives way to the latter with increasing elevation. Beardless bluebunch wheatgrass (*Agropyron spicatum* var. *inerme*) is the principal grass of the region and is dominant in both associations. The subdominant grasses are Sandburg bluegrass (*Poa secunda*) and Idaho fescue (*Festuca idahoensis*). Junegrass (*Koeleria cristata*) is also abundant. Other grasses present but of minor importance are *Stipa columbiana*, *S. Richardsoni* and *Danthonia intermedia.*

Among the forbs, yarrow (*Achillea millefolium*) is considerably more abundant than any other. Of secondary importance are pussy toes (*Antennaria* sp.), dandelion (*Taraxacum officinale*), lupine (*Lupinus sericeus*), scorpion weed (*Phacelia* sp.) and wild onion (*Allium cernuum*). Abundant chamaephytes (half-shrubs) are pasture sage (*Artemisia frigida*) and umbrella plant (*Eriogonum heracleoides*).

Quantitative data on plant abundance were obtained at eight widely scattered sites on South Slope. The sites sampled varied considerably in species composition as a result of differences in elevation, exposure, soil development and grazing history. When averaged, bluebunch wheatgrass made up 26% of total plant cover and all other grasses combined made up 38.5%. Forbs and chamaephytes made up 19% and 16.5% respectively of total plant cover. Living plants made up about 47% ground cover, plant litter about 11%, and exposed soil and rock 42%.

From comparison of South Slope data with those for a nearby slope of similar elevation and exposure, but having no history of cattle grazing and little use by sheep or deer, it is evident that the former range (Figure 1) has deteriorated somewhat from the climax condition. On the "relict" slope, bluebunch wheatgrass was more than twice as abundant as on South Slope, as was Idaho fescue. However, those were virtually the only grasses occurring there. Forbs and chamaephytes were slightly less abundant on the "relict" slope, and exposed soil made up only 12% of the area sampled.

Forage yield, determined by clipping six 12 x 14 foot large mammal exclosure plots on the South Slope range, varied from 241 to 871 pounds of air-dried matter per acre. The mean was about 690 pounds, with all but one site producing over 600 pounds per acre.

FOOD HABITS

Sheep foods as determined by four methods are listed in Table 1. Figure 2 compares sheep food habits, in terms of vegetation classes, with the availability of those classes on two ranges.

Pasture sage and bluebunch wheatgrass were the plants most often eaten in winter. They made up 35 and 36 per cent of the diet respectively. Pasture sage was actively sought out by sheep especially during early winter. At that time many of the pasture sage leaves are not cured and dry as are most grasses and forbs. As winter progressed the pasture sage became depleted. Therefore the December trailing observations show a higher percentage of this

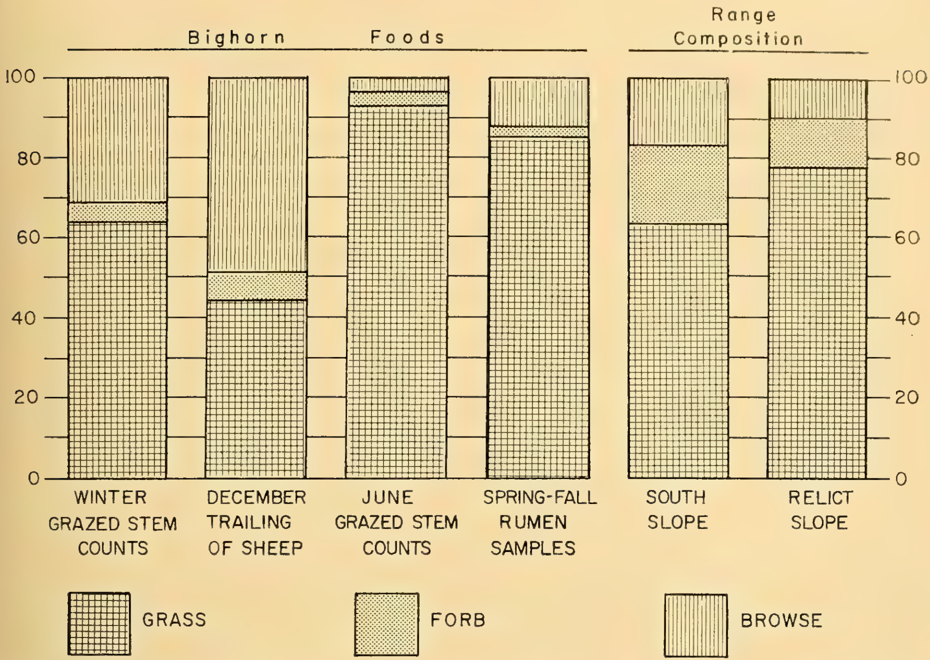

FIGURE 2. Comparison of bighorn foods, in terms of vegetation classes, with forage availability on climax and subclimax ranges.

species than the overall winter picture from grazed stem counts. Sheep often pawed through several inches of snow to obtain pasture sage when abundant bunchgrass protruded. Sugden (1961) also found that pasture sage and bluebunch wheatgrass were the preferred food species of California bighorns in the Chilcotin area of British Columbia. Pasture sage was used to a greater extent than the bunchgrass and he concluded that to be a reflection of the bighorns' preference. My data tend to confirm that conclusion.

Ashnola bighorn sheep averaged 54% grass in their winter diet, but 72% over the fall-winter-spring period. Couey (1950) found that the stomachs of six bighorn sheep which died in late fall and winter contained an average of 63% grass. Murie (1944) found that grasses made up 81.5% of the fall-winter-spring diet of Dall sheep (*Ovis dalli dalli*) in Alaska, somewhat higher than Ashnola figures.

With the advent of new spring growth, the amount of grass in the sheep diet rises sharply while pasture sage decreases. The relative amount of bluebunch wheatgrass in the grass class also decreases. Downy brome, which matures very early was only eaten by sheep in May and early June. The rumen sample data, being a mixture of spring and early fall diets, fall between the winter and spring diets of Figure 2 with respect to relative amounts of grasses and browse eaten.

True shrubs were not an important segment of the sheep diet at any time of the year. The browse class in Figure 2 consists almost entirely of pasture sage, a half-shrub or chamaephyte. The only true shrub occurrences in the quantitative determination of sheep food preference were 1% or less of squaw current, kinnickinik, blueberry and willow.

Several minor food items not recorded in Table 1 were eaten from time to time. In the winter sheep occasionally nibbled at Douglas fir (*Pseudotsuga menziesii* var. *glauca*) and Englemann spruce (*Picea engelmanni*). In the spring, ram groups were seen eating soopolallie (*Shepherdia canadensis*), currant (*Ribes hudsonianum*) and red raspberry (*Rubus idaeus*). Death camas (*Zygadenus venenosus*), a species highly toxic for domestic stock, was eaten in the spring with no observed ill effects. The seed pods of lupines, many species of which are poisonous for domestic sheep (Sampson, 1952) were eaten in winter.

A striking feature of the former range of *O. c. californiana* is that from its northernmost point in British Columbia to the Mount Shasta area of northeastern California, it was contiguous with the Bunch Grass Grassland zone of North America (see map in Shelford 1963, p. 330). Unfortunately, this sub-species of bighorn was extirpated in Washington, Oregon and northern California within historic times, therefore it is not possible to make comparisons of bighorn food habits throughout this phytogeographic zone. The only data on food habits of *O. c. californiana*, other than those of Sugden (*op. cit.*) and myself, appear to be those of Jones (1950). However, his studies were confined to the east slope of the Sierras in central California, an area not within the Bunch Grass Zone, and of considerably different floristic composition.

SUMMARY

Data are presented relating utilization of forage by the Ashnola bighorn herd to species composition of the winter-spring range. Botanical composition of the range was evaluated with line-point transects. Bighorn food habits were determined by trailing sheep in newly fallen snow, by counting grazed stems after winter and spring use, and by analysis of rumen samples.

Grasses made up an average of 72% of the diet from late September to mid June, forbs 4% and browse 24%. Bluebunch wheatgrass, the climax dominant of Ashnola winter ranges, was also the most important species in the bighorn diet. Sub-dominant grasses of secondary importance in the sheep diet were bluegrasses and junegrass. The only other plant of any significance in the bighorn diet was pasture sage, which accounted for 82% of the browse eaten. That species was relatively abundant on the range.

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REFERENCES

BLOOD, D. A. 1961. An ecological study of California bighorn sheep *Ovis canadensis californiana* (Douglas) in southern British Columbia. M.Sc. thesis, University of British Columbia, 127 p.

————. 1963a. Some aspects of behavior of a bighorn herd. The Canadian Field-Naturalist 77(2):77-94.

————. 1963b. Parasites from California bighorn sheep in southern British Columbia. Canadian Journal of Zoology 41(6): 913-918.

COUEY, F. M. 1950. Rocky Mountain bighorn sheep of Montana. Montana Fish and Game Commission Bulletin No. 2, 90 p.

DASMANN, W. P. 1951. Some deer range survey methods. California Fish and Game 37(1):43-52.

JONES, F. L. 1950. A survey of the Sierra Nevada bighorn. Sierra Club Bulletin 35:29-76.

MURIE, A. 1944. The wolves of Mount McKinley. Fauna of the National Parks of the United States, Fauna Series No. 5, 238 p.

SAMPSON, A. W. 1952. Range Management. John Wiley and Sons, New York. 570 p.

SHELFORD, V. E. 1963. The ecology of North America. The University of Illinois Press, Urbana. xxii + 610 p.

SUGDEN, L. G. 1961. The California bighorn in British Columbia with particular reference to the Churn Creek herd. British Columbia Department of Recreation and Conservation. 58 p.

TISDALE, E. W. 1947. The grasslands of the Southern Interior of British Columbia. Ecology 28(4):346-382.

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NOTES ON THE DISTRIBUTION OF TWO GRASSES, *SPOROBOLUS NEGLECTUS* AND *LEERSIA VIRGINICA*, IN QUEBEC*

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Sporobolus neglectus Nash

This little annual has a broad range in temperate North America with its northern limits in southern Quebec, southern Ontario and in the southern part of Prairie Provinces.

The records of occurrence in Quebec are concentrated in the south and southwestern part of the province (Figure 1). The first evidence of occurrence of the plant to the northeast of the area just mentioned was provided by the collections of M. Raymond and J. Kucyniak at Leeds Station, Beauce County, in 1946, and at Grondines, Portneuf County, in 1953. A collection by the authors in 1962, also at Grondines, was made independently and from a different habitat. As now known, Grondines is the most northerly station at which *Sporobolus neglectus* occurs in Quebec.

Closer inspection of the flora through additional surveys in the intermediate area would likely reveal a more uniform distribution than illustrated in the plot map (Figure 1). This inconspicuous *Sporobolus* is easily overlooked and consequently is not often collected by botanists, mainly because its presence is obscured in land dominated by other grasses. It germinates late in the season and does not become noticeable until the middle of August or later, and, even then, its panicles are seldom extruded from their leaf sheaths. Like the closely similar species *S. vaginiflorus*, it typically produces its seed cleistogamously, completely hidden from view. In the field it can best be recognized from the seedlings of other grasses by its vegetative characters and habit of growth.

As to the ecological relationships of *S. neglectus*, one observes that it is almost always associated with soils that become very disiccated at some periods in the season but very wet at others. Like *Poa compressa*, it seems well fitted to tolerate such extremes of wetness and dryness, also extremes of high and low soil temperature. It is for this reason that *S. neglectus* is frequently found on shallow soils, in pastures where the turf is subject to "working" by frost action, and on road margins or railways. Under the natural conditions which originally existed in Eastern Canada, this little plant, strictly heliophilic, must have been confined to rocky river-shores and other open habitats where competing species were continually eroded away or eliminated by other means.

The collection of Raymond and Kucyniak at Grondines in 1953 was probably from one of these naturally open habitats along the St. Lawrence River: "grève; au sec dans le cailloutis", where the *Sporobolus* would be

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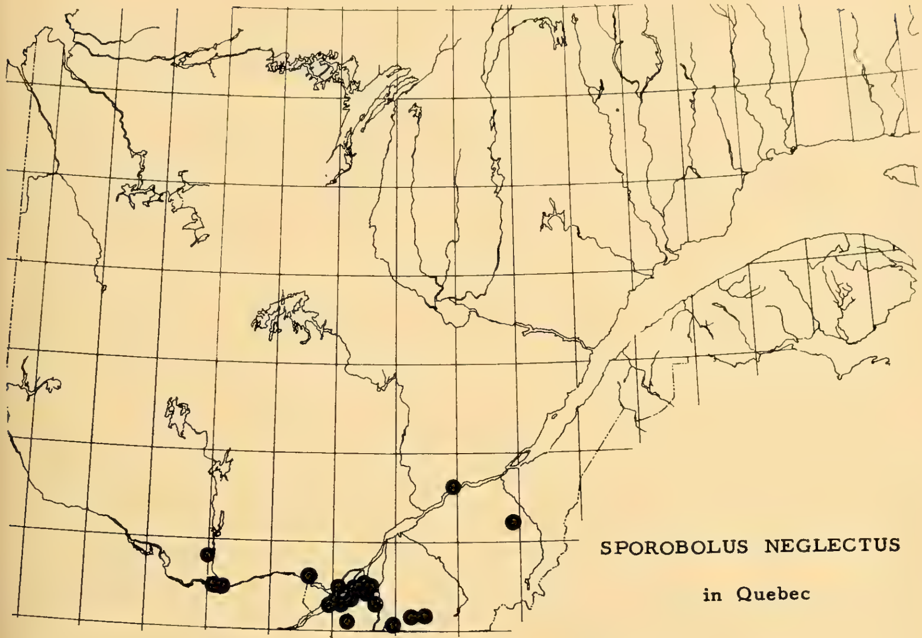

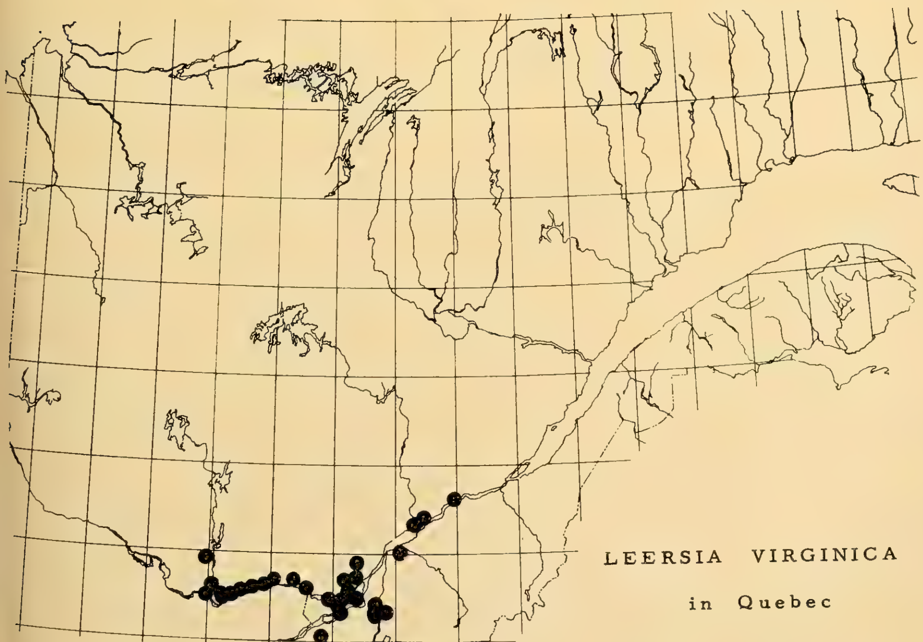

Figure 1. Distribution of *Sporobolus neglectus* Nash in Quebec.
Figure 2. Distribution of *Leersia virginica* Willd. in Quebec.

considered indigenous. Our collection of 1962 was made in a pasture of *Festuca rubra* and *Poa compressa* on an outcropping of Trenton limestone at a point about two miles back from the river and at some elevation above it. Originally this pasture area would have been under dense forest. The *Sporobolus* has surely been locally introduced to the rocky pasture site in post-settlement times being transferred most likely as seeds attached to vehicles or in soil adhering to implements or livestock. The seed has a gelatinous pericarp when wet. The occurrence at Leeds Station: "champs pauvres", is also considered an introduction.

Leersia virginica Willd.

Leersia virginica is a grass of wet woods usually restricted, in Quebec, to the immediate flood-plains of the Richelieu, the lower Ottawa, and upper St. Lawrence (Figure 2).

During fieldwork in 1961 and 1962 we discovered this grass at Grondines, in a clearing in a patch of old maple woods containing a few hickory (*Carya cordiformis*) trees. The woodland is situated on ground moraine at an elevation of about 100 feet above sea-level (or, above the estuarine level of the nearby St. Lawrence), about a mile northwest of the village. Here at Grondines, as at Athelstan, Kazabazua, and on the slopes of the Monteregians, the *Leersia* grows in deciduous woods, somewhat removed and entirely independent from the flood plain conditions of present rivers.

Since *L. virginica* reproduces with difficulty by means of seeds, it is quite hazardous for us to suppose that it has attained these elevated woodland sites during recent times. Rather, it is more plausible to say that an ancient migration took place along wet shorelines marking a retreating Champlain Sea, or at a time when a more favourable climate permitted ready reproduction and establishment by seed. At the present, it is obvious that migration of *L. virginica* is effected solely by the stubby rhizomes, shallowly attached to the base of the plant, which become loosened and transported by flowing waters. It is thought that this arrangement does not pertain to the area to the south nearer to the climatic center of the species.

REFERENCES

DORE, W. G. 1959. Grasses of the Ottawa District. Canada Department of Agriculture, Publication 1049.

DOYON, D. 1962. Distribution de plusieurs espèces méridionales sur la rive nord du Saint-Laurent. Programme 30e Congrès ACFAS: 46.

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THE WINTER DIET OF BARREN-GROUND CARIBOU IN NORTHERN CANADA

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Information is limited on the winter food of barren-ground caribou (*Rangifer tarandus groenlandicus*) in northern Canada. A tendency exists in popular and some scientific literature to consider lichens as almost the sole source of winter food. The purpose of this study was to test that assumption, to provide data for correlation with research on the winter range (Scotter, 1964), and to fill a gap in previous caribou research programs (Banfield, 1954; Kelsall, 1957, 1960).

Study Area

The winter range of barren-ground caribou is largely restricted to the coniferous forest belt, or taiga, of northern Canada. Of the approximately 295,000 square miles of this range, the greater portion lies within the Percambrian Shield region of Northwest Territories, northern Saskatchewan, northern Manitoba, and the northeastern corner of Alberta. The forests are predominantly coniferous in character, with hardwood trees occurring in some fire disturbed regions. The major tree species are black spruce (*Picea mariana*), white spruce (*Picea glauca*), jack pine (*Pinus banksiana*), and white birch (*Betula papyrifera*). The ground cover consists of shrubs, most of which are ericaceous, carpets of lichens and bryophytes, forbs, and grasses and grass-like plants. More detailed description of the forest regions can be found in Rowe (1959).

Methods

Samples of rumen contents were collected from 20 barren-ground caribou in Manitoba, Saskatchewan, and the Northwest Territories between October and April. The majority of the samples were obtained in December and January. Samples were placed in plastic bags and frozen until used in the study. The method used to determine the percentage composition by weight was that used by Scotter (1966). Each sample of approximately 250 ml was washed through a gang of three sieves with mesh openings of 4.76 mm (No. 4), 2.83 mm (No. 7), and 2.00 mm (No. 10), respectively.

Cumulative percentages were obtained by totaling the air-dried weight of each forage species or group from the three screens and that total was divided by the total weight of all forage found in the three screens. This is desirable since species or forage groups are seldom equally represented in the three sieves. The results are the same as would be obtained by using a 10-mesh sieve size by itself. Data for other purposes were obtained by using the three sieves and then obtaining a cumulative percentage.

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Reference plant collections were used to identify the fragments remaining on the screens. Dr. A. E. Porsild, Dr. H. A. Crum, and Dr. J. W. Thomson assisted with some identifications of vascular, bryophyte, and lichen fragments, respectively.

In a few cases material from screens of 20 and 40 meshes per inch were examined microscopically to determine if changes in composition of the diet could be detected. Frequency counts were made since the particles were too small for manual separation.

RESULTS AND DISCUSSION

The forage in the rumen samples was grouped into six classes: lichens, grass and grass-like plants, woody plants, forbs, others, and unidentifiable material. Fruticose lichens of the genus *Cladonia* were the major source of food, comprising more than 50 per cent of the total forage (Table 1). Other fruticose lichens, such as *Stereocaulon* and ground growing species of *Cetraria*, and foliose lichens, such as *Peltigera*, were only a small part of the total lichens consumed. The presence of *Peltigera* spp. as the second most abundant genus was surprising, however, since some literature indicated it was avoided by reindeer (Hustich, 1951). Small amounts of arboreal lichens (*Alectoria* sp. and *Usnea* sp.) were found in three rumens. Lichens of all species comprised 73.0, 54.8, and 52.2 per cent of the total forage sampled from Saskatchewan, Manitoba, and the Northwest Territories, respectively. The frequency of occurrence of each lichen group is indicated in Table 1.

Although these data support the belief that terrestrial lichens are an important constituent of the winter diet, they indicate that a great number of other plants are also eaten. Forage plants belonging to the graminoid group were found in all the samples, with as much as 11 per cent in one rumen. Evergreen plants of the Ericaceae, such as *Vaccinium vitis-idaea* v. *minus*, and *Ledum groenlandicum* or *L. decumbens*, were present in all rumen samples, but this was to be expected since the family is abundant over much of the caribou winter range. It is likely that leaves of *Vaccinium myrtilloides*, *V. uliginosum*, *Betula glandulosa*, and other deciduous plants identified in the samples were ingested as dry and fallen leaves with lichen forage, at least to some extent.

Fungi and bryophytes were present in small amounts; the latter were possibly eaten as incidentals with terrestrial lichens. Fungi were actively sought by caribou during the autumn according to Banfield (1954). During winter months, however, they would be less available.

Forbs were identified in only two samples. One sample contained a trace of Leguminosae and two samples contained a small amount of *Cornus canadensis*.

Unidentifiable material made up about 16 per cent of the forage retained by the sieves. Most of that material was woody. Some miscellaneous items were present in the rumens. Bird feathers and three colors of plastic flagging tape were found in portions of rumen contents not separated.

No plant groups could be identified visually beyond the 10-mesh per inch screen size with a high degree of certainty, although the color of lichens

TABLE 1. — Percentage composition, air-dry weight, and percentage occurrence of food items in barren-ground caribou rumen samples collected during winter months.

Food Item	Manitoba	Saskatchewan	Northwest Territories	All	
Area:	Manitoba	Saskatchewan	Northwest Territories	All	
No. of Samples:	6	10	4	20	
Basis:	Weight	Weight	Weight	Weight	Occurrence
Cladonia spp.[1]	46.4	62.5	40.5	48.4	100
Cladonia spp.[2]	2.4	1.3	1.1	2.1	100
Peltigera spp.	2.6	6.2	4.5	4.1	100
Cetraria spp.	0.7	0.7	0.1	0.5	80
Stereocaulon spp.	2.7	2.3	6.0	2.4	100
Alectoria sp.		tr		tr	10
Usnea sp.	tr			tr	5
Lichens	54.8	73.0	52.2	57.5	
Grasses and sedges	4.1	0.6	0.8	2.8	95
Equisetum spp.	0.1	0.2	0.1	0.1	95
Grass and grass-like plants	4.2	0.8	0.9	2.9	
Vaccinium vitis-idaea v. *minus*	3.4	0.8	6.5	3.4	100
Vaccinium myrtilloides	0.7	tr		0.3	40
Vaccinium uliginosum	1.1	0.1	0.1	0.6	85
Ledum groenlandicum and *L. decumbens*	3.6	0.9	4.9	2.9	100
Salix spp.	0.1	tr		0.2	65
Empetrum nigrum	0.1	0.1	0.1	0.1	70
Andromeda polifolia	0.4	tr	tr	0.2	70
Chamaedaphne calyculata	tr	tr		0.1	55
Loiseleuria procumbens			0.6	tr	10
Cassiope tetragona			0.2	tr	5
Arctostaphylos uva-ursi		0.1		tr	15
Shepherdia canadensis				tr	5
Linnaea borealis v. *americana*				tr	10
Betula glandulosa	0.1	tr	0.5	0.6	100
Picea spp.	9.4	5.3	11.6	6.7	95
Larix laricina	0.1	0.2	0.2	0.3	80
Pinus banksiana	3.1	3.9	1.7	4.5	85
Woody plants	22.1	11.4	26.4	19.9	
Cornus canadensis		tr		tr	10
Leguminosae		tr		tr	5
Forbs		tr		tr	
Bryophytes	2.1	2.0	3.7	3.1	100
Fungi	0.2	0.3	tr	0.4	75
Others	2.3	2.3	3.7	3.5	
Unidentifiable material	16.6	12.5	16.8	16.2	100
Total	100.0	100.0	100.0	100.0	

[1]This group included the "reindeer" lichens such as *Cladonia alpestris*, *C. mitis*, *C. rangiferina*, and *C. uncialis*.
[2]This group included the so-called cup and horn lichens such as *Cladonia cornuta* and *C. gracilis*.

allowed frequency estimates in smaller mesh sizes. The frequency of lichens in screens of 20 and 40 meshes per inch generally was slightly higher than the counts from those of 10 meshes per inch. The percentage of lichens did not invariably increase as the size of the particles decreased. In two of the 20 rumens studied, for example, a higher proportion of lichens was present in the screen of mesh size four than in the screen of mesh size seven. This may have resulted because the animals were collected shortly after feeding. A second possibility is that they had eaten lichens which were more moist than usual and less subject, therefore, to fragmentation.

In the few samples where the finer material was studied, protozoa were frequently found in the material which passed through the 40-mesh screen size. Some of these have been sent to Dr. G. Lubinsky, University of Manitoba, for identification.

The use of forage other than lichens has an important implication when the chemical composition of forage plants is considered. Although lichens appear to be an adequate source of carbohydrates, most of the important forage lichens fail to meet an adequate protein level (Scotter, 1965). Utilization of other forage plants may be essential for the well-being of barren-ground caribou.

It is not unusual for some barren-ground caribou to winter on the tundra rather than in the taiga region. One sample, taken from an animal in a tundra community, was markedly different in composition from those taken in the forested region. Lichens constituted only 6.1 per cent of the sample in contrast to an average of 57.5 per cent for all 20 samples. The larger portion of the tundra sample was unidentifiable material. Approximately 34 per cent of the sample was woody tissue which could not be identified, even with expert assistance.

A considerable amount of the 250 ml samples passed through the three screen meshes. The average volume retained was 20 per cent, with a range of 8 to 34 per cent. Rumen fluids, rumen organisms, and food particles passed through the finest of the three screens. Courtright (1959) reported that a single 10-mesh screen size retained less than 5 per cent of the sample in his Alaskan study. He was critical of caribou rumen analyses, in part, because about half of his sample would pass through screens of 200 meshes per inch. Part of that material, however, consisted of protozoa.

Swift and Bishop (1963) reported results similar to the present study, with about 20 per cent of the sample being retained with a screen mesh size of 1.68 mm. They also reported that the amount of lichens increased from coarser to finer screen mesh sizes. Lichens comprised 31.2 per cent of the total material retained by screen mesh sizes 4, 7, and 10 compared with 38.3 per cent of the total material to screen mesh size 200. They reported difficulties were encountered in making the transition from macroscopic techniques in the larger screen mesh sizes to microscopic techniques in smaller screen mesh sizes.

The stomach contents studied were so finely divided that manual segregation of the fragments was tedious and time consuming. Time required for the segregation of the particles from the three screen sizes ranged from about

30 to 55 hours, and the average for the twenty rumen samples was about 37 hours. Dietary studies for management purposes generally do not warrant such an expenditure of time. Visual estimates of the proportions of fragments within a screen may be the only practical means of determining food habits for that purpose. Variables, such as the wide geographic distribution of the samples, the effect of snow conditions on availability of various forages, and delayed assimilation of various forages by caribou, preclude highly accurate results. However, data obtained by using the 10-mesh screen size would appear to be a useful index of caribou feeding habits, subject to no more criticism than other techniques, such as feeding minutes or food crater studies. It is probable that minimal estimates are obtained for fragile plants, such as terrestrial and arboreal lichens, which are subject to rapid digestion, and that the abundance of jack pine needles and spruce needles is over estimated because of their greater resistance to digestive processes. Such uncontrollable variables in rumen analysis must be recognized, and caution should be used in interpreting the results.

COMPARISON WITH PREVIOUS STUDIES

The only other study of the winter diet of barren-ground caribou in northern Canada was made by Kelsall (1960). He studied the frequency of occurrence of individual plant species found at the base of winter feeding craters, which were dug into snow by the animals' forefeet. Lichens, *Vaccinium* spp., sedge, *Ledum groenlandicum*, and *Salix* spp. constituted 47, 21, 13, 8, and 4 per cent, respectively, of the plants utilized. Banfield (1954) has also made general comments on the winter diet of barren-ground caribou.

Additional comparisons with other species of caribou are possible. In Alaska, Skoog (1956) reported that 30 to 55 per cent of the winter food consumed by caribou was lichens, according to rumen analyses. The mean percentage of lichens, woody plants, grass-sedge, fungi, and moss was 55, 15, 25, trace, and trace, respectively, in the 19 samples collected during November. Adolf Murie (1944, p. 153) in Mount McKinley National Park considered that, "One of the requirements of a wintering ground seems to be the presence of lichens, even though they by no means form the exclusive diet." In Ontario, Cringan (1957, p. 493) noted that "The utilization of woody foods by Slate Islands caribou was so low contrasted to that of arboreal and terrestrial lichens, that clearly the supply of lichens is critically important, while that of browse is relatively unimportant." In Wells Gray Park, British Columbia, arboreal lichens provided the main food source (Edwards and Ritcey, 1960). The possible importance of arboreal lichens to barren-ground caribou has been previously reviewed (Scotter, 1962). In the present study only three rumens contained trace amounts of those lichens. There may be two explanations for the small amounts present. Bergerud and Russell (1964) noted that some arboreal lichens disappear in the digestive process more quickly than other plants. In one instance *Alectoria sarmentosa* had disappeared from a rumen 4½ hours after ingestion. Greater amounts of arboreal lichens might have been found if more samples had been taken late in the winter, when availability

of terrestrial forage plants may be reduced by the thickness of the snow cover or hardness of the crust. Cowan (1945), however, reported large amounts of arboreal lichens in the rumens of black-tailed deer (*Odocoileus hemionus columbianus*). He did not record any difficulty in finding them in his samples.

Other plants provided important forage to wintering caribou in some previous studies. The Alaska-Yukon caribou herd, according to Olaus Murie (1935), utilized large quantities of grasses. Lichens were next in abundance. Adolph Murie (1944) found that grasses, sedges, and willows were eaten extensively by the Mount McKinley caribou.

SUMMARY

A study of the winter food of barren-ground caribou in northern Canada was conducted as part of an intensive research program. Analyses of 20 rumen samples were made by washing 250 ml of rumen contents through a gang of three sieves with openings of 4.76 mm, 2.83 mm, and 2.00 mm. Forage particles from each sieve were separated and weighed. The weights of each species or forage group were combined to give an aggregate percentage composition. This helps to reduce error caused by unequal representation of food items in the three sieves.

The data indicate that terrestrial lichens are the most abundant plants in the winter diet of barren-ground caribou, constituting more than 50 per cent of the food intake. Although lichens dominate the winter diet, caribou are rather catholic in their feeding habits and many items are included in addition to lichens. A number of woody plants, several grass and grass-like plants, and many species of bryophytes composed 19.8, 2.9, and 3.1 per cent of the diet, respectively.

Some of the limitations of rumen analyses, such as differential digestion rates of some plants, are discussed. Although caribou stomach analyses are not highly accurate, they still provide an index to food habits not subject to some of the limitations of other methods. The value of rumen analyses may be improved by using them in connection with other methods of diet determination, such as feeding crater studies.

REFERENCES

BANFIELD, A. W. F. 1954. Preliminary investigation of the barren-ground caribou. Canadian Wildlife Service, Wildlife Management Bulletin, Series 1, 10B:1-112.

BERGERUD, A. T. and L. RUSSELL. 1964. Evaluation of rumen food analysis for Newfoundland caribou. The Journal of Wildlife Management 28(4):809-814.

COURTRIGHT, A. M. 1959. Results of some detailed analyses of caribou rumen contents. Proceedings Alaskan Science Conference 10:28-36.

COWAN, I. MCT. 1945. The ecological relationships of the food of the Columbian black-tailed deer, *Odocoileus hemionus columbianus* (Richardson), in the coast forest region of southern Vancouver Island, British Columbia. Ecological Monographs 15(2):109-139.

CRINGAN, A. T. 1957. History, food habits and range requirements of the woodland caribou of continental North America. Transactions of the North American Wildlife Conference 22:485-501.

EDWARDS, R. Y. and R. W. RITCEY. 1960. Foods of caribou in Wells Gray Park, British Columbia. Canadian Field-Naturalist 74(1):3-7.

HUSTICH, I. 1951. The lichen woodlands in Labrador and their importance as win-

ter pastures for domesticated reindeer. Acta Geographica 12(1):1-48.

KELSALL, J. P. 1957. Continued barren-ground caribou studies. Canadian Wildlife Service, Wildlife Management Bulletin, Series 1, 12:1-148.

———. 1960. Co-operative studies of barren-ground caribou 1957-58. Canadian Wildlife Service, Wildlife Management Bulletin, Series 1, 15:1-145.

MURIE, A. 1944. The wolves of Mount McKinley. United States Department of the Interior, National Park Service, Fauna of the National Parks of the United States, Fauna Series No. 5. 238 p.

MURIE, O. J. 1935. Alaska-Yukon caribou. United States Department of Agriculture, Bureau of Biological Survey, North American Fauna, No. 54. 93 p.

ROWE, J. S. 1959. Forest regions of Canada. Department of Northern Affairs and National Resources, Forestry Branch, Bulletin 123. 71 p.

SCOTTER, G. W. 1962. Productivity of arboreal lichens and their possible importance to barren-ground caribou (*Rangifer arcticus*). Archivum Societatis Zoologicae Botanicae Fennicae 'Vanamo'. 16(2):155-161.

———. 1964. Effects of forest fires on the winter range of barren-ground caribou in northern Saskatchewan. Canadian Wildlife Service, Wildlife Management Bulletin, Series 1, 18:1-111.

———. 1965. Chemical composition of forage lichens from northern Saskatchewan as related to use by barren-ground caribou. Canadian Journal of Plant Science 45(3): 246-250.

———. 1966. Sieve mesh size as related to volume and weight analysis of caribou rumen contents. Canadian Field-Naturalist 80:238-241.

SKOOG, R. O. 1956. Range, movements, population, and food habits of the Streese-Fortymile caribou herd. Unpublished Master of Science thesis, University of Alaska, College. xii + 145 p.

SWIFT, L. H. and R. H. BISHOP. 1963. Analysis of plant materials in the rumen of caribou of Northwestern Alaska. Unpublished manuscript, Project Chariot, Department of Biological Sciences, University of Alaska. 29 p.

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THE MAMMALS OF SABLE ISLAND

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The natural history of Sable Island has been well summarised by Erskine (1954, 1955) who, though primarily interested in the flora of the island, listed several species of mammals seen. Apart from an account of the introduced horses, *Equus caballus*, he mentioned seeing only common porpoises *Phocaena phocaena* and harbour seals *Phoca vitulina.* The red and black foxes, presumably *Vulpes fulva,* once said to be common on the island, were not seen by him and neither were any rats or mice in evidence.

In June 1961 I flew to Sable Island with Dr. H. D. Fisher specifically to make an estimate of the seal population there and to extend our investigations on the general life history of the harbour seal and the grey seal, *Halichoerus grypus.* Our initial survey of the island on June 15 was followed by a week spent among the dunes and along the beaches, observing and counting seals and taking selected specimens for laboratory study. A final aerial survey on June 27 (Figure 1) enabled us to reconfirm our estimates of the seal populations and to count the horses in the island's herd. In addition to our own observations we collected verbal reports from past and present residents of the island.

On January 26, 1962, I flew over Sable Island with my assistant T. R. Welch and we were able to confirm former reports that grey seals breed there. This aerial survey was followed by another on January 31, 1963, and then from February 3 to 9 T. R. Welch and I stayed on the island observing the breeding seals and counting and marking the pups. Further marking expeditions were made by myself and two senior technicians from the Arctic Biological Station, B. Beck and I. Gidney, in February 1964, and by B. Beck and I. Gidney in February 1965.

Pinnipedia

Family Phocidae

Halichoerus grypus, grey seal, "horse head"

The first reliable report of grey seals occurring regularly at Sable Island was made by Gilpin (1870). He recorded that "sometimes in January, but more often in February, a herd of several hundred large seals made their appearance upon the N. East bar, if molested they reappear upon the S. W. bar, where they remain if undisturbed the whole summer, they and their little ones —for they usually whelp in early spring. They are called characteristically enough, by the patrolmen ocean bulls, but I fancy are either *P. barbata*, or *H. gryphus*, or perhaps both, as Dr. Gill has certainly identified the great grey seal on Sable Island. I saw them there in June of 1854, but had none of them in hand. By galloping down upon their line of retreat, I was enabled to close upon them as they shouldered or hummocked themselves into the sea. The bristly moustache of the old ones, and the white and spotted coats of the pups, very much resembled the plates of *P. barbata*, whilst their size at once separated them from the common seal *P. bitulina* which constantly inhabit the island."

Apart from his confusion between the grey seal and the bearded seal, *Erignathus barbatus*, which could occur only as a very

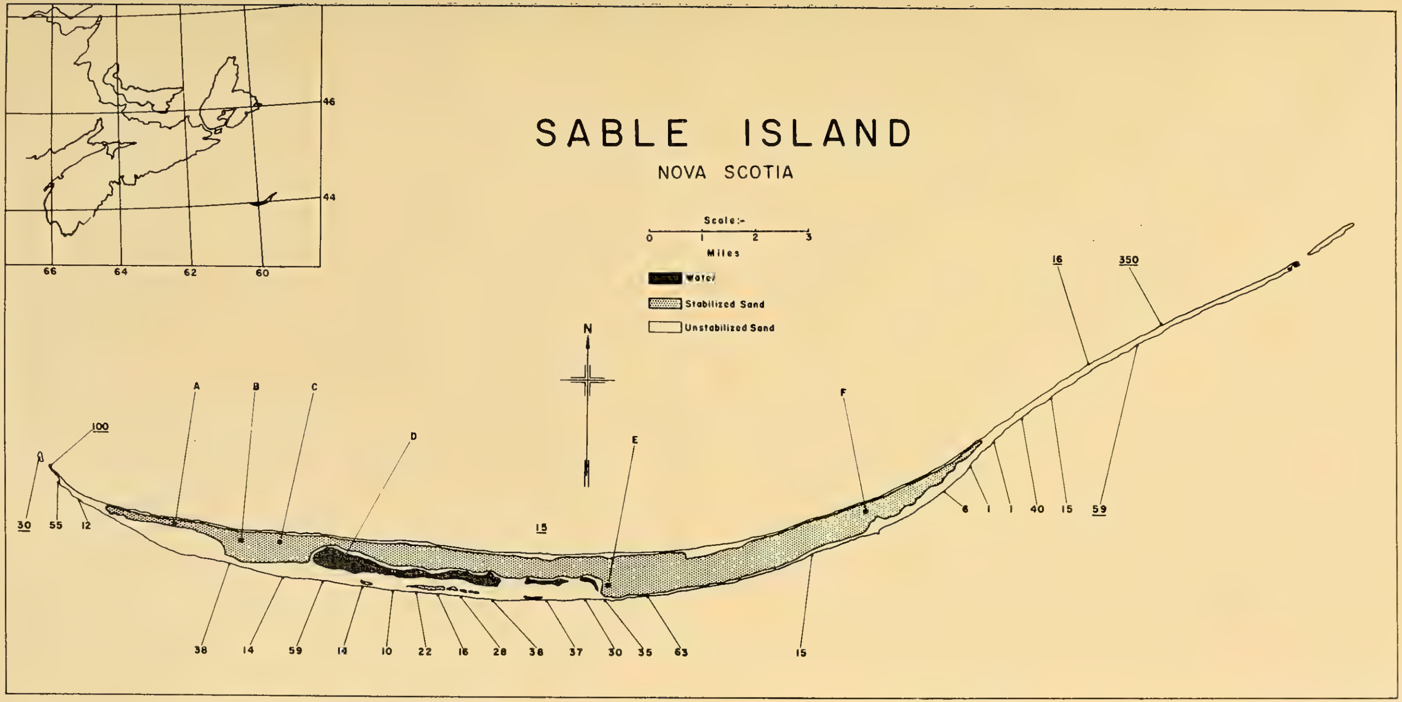

FIGURE 1. Map of Sable Island showing distribution of grey seals (underlined figures) and harbour seals on June 27, 1961. Other details: A. Abandoned old main station. B. Present radio station and light. C. Meteorological (radiosonde) station. D. Wallace Lake. E. Abandoned No. 3 life-saving station. F. East Light.

FIGURE 2. Adult male grey seal (right), female (centre) and whitecoated pups (left).

rare stray at Sable Island, his description of the species is quite accurate.

Our own observations began in 1949 when Dr. D. M. Scott of the Fisheries Research Board of Canada, St. Andrews, New Brunswick, studying the life history of the cod worm *Porrocaecum* (synonyms: *Phocanema, Terranova) decipiens*, received a collection of small harbour seal stomachs and large grey seal stomachs from the island. Dr. H. D. Fisher confirmed the identification of these seals from the lower jaws sent with the stomachs. Correspondence with Captain Patrick Solowan, Department of Transport superintendent on Sable Island, indicated the existence of considerable numbers of both species of seals and confirmed that the animals seen in February 1948 were whelping grey seals.

On our first aerial survey on June 15, 1961, we saw just over 400 grey seals distributed as follows: 150 hauled out in one large group at the end of the western spit, 15 scattered along the north shore in the shallow water and 250 hauled out in another large group about two-thirds the way along the eastern spit. They were easily distinguished from the harbour seals by their uniformly dark grey colour, both when hauled out on the sand and when swimming. This disposition was maintained throughout our stay on the island, the grey seals remaining in several large groups well out on the bare sand spits away from the consolidated dunes. Their exposed position made observation of them difficult and we were only able to stalk the animals unawares when they were lying on the steeper lower part of the beach. On June 16 we observed a group of 190 at the extreme western end of the island. All age groups appeared to be present since we could identify young of the year, as well as immatures of both sexes and adult males and females. The animals were closely packed together in one large group which took to the water very quickly when disturbed by us. They remained about 100 yards offshore, watching our activities with apparent interest. The large size of the young indicated that birth had taken place some months previously, and lent support to the other evidence for a late winter whelping period.

On June 27, 1961, we counted from the air the following numbers of grey seals: 425

TABLE 1. — Approximate age groupings of grey seal pups (after E. A. Smith, *in litt.*)

Group	Age in weeks	
I	0–1	thin body, prominent head, raw umbilical cord.
II	1–2	medium size, head streamlined into body, white natal coat fast, umbilicus healed.
III	2–3	large size, fat, moult not really started.
IV	3–4	white natal coat moulting on head, flippers and centre of back, hair pulling easily.
V	4–	fully moulted.

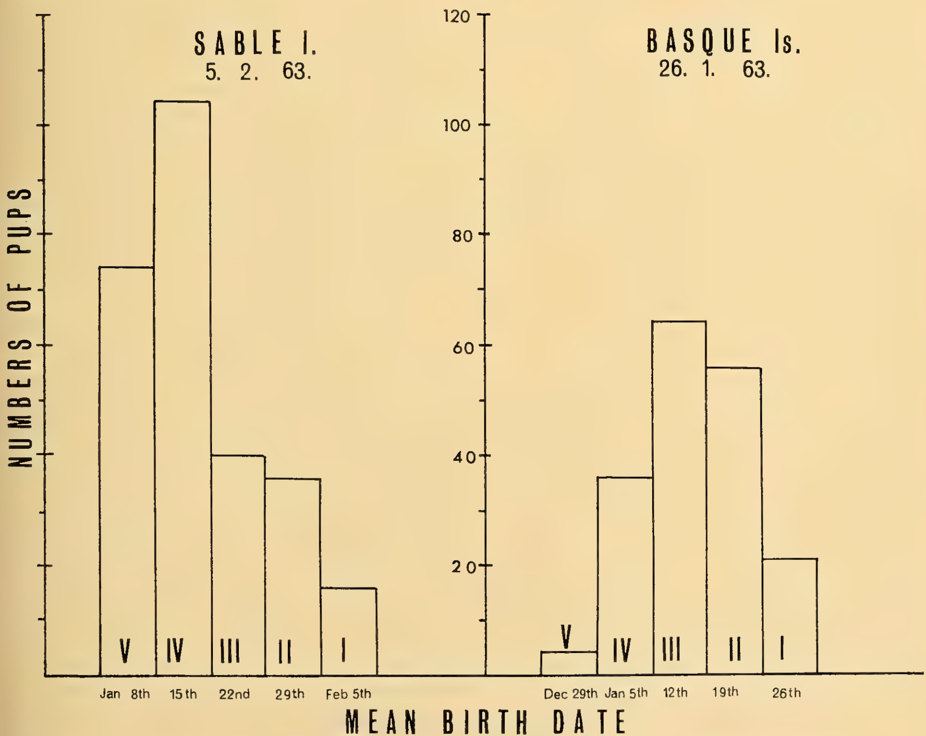

FIGURE 3. Age-frequency distribution of pups tagged at the Basque Islands and Sable Island. Roman figures denote the age groupings described in Table I.

in two groups on the east spit, 15 along the north coast and 100 in two groups at the end of the west spit, with another 30 on a sand bar a few hundred yards further on.

On January 26, 1962, we again observed much the same distribution, though now the seals were scattered rather than being packed into a few dense groups. Most of the breeding seals were confined to the proximal four miles of the eastern spit, since the remainder of the sand bar, except for several hundred yards at the eastern tip, was flooded. We counted 99 adult males, 161 females with possibly some immatures, and 112 white

FIGURE 4. Beach on north side of long dune showing three breeding females and pups accompanied by three adult males.

coated pups. Fewer seals were at the west end of the island, our total count there being only 2 males, 21 females and 22 pups.

On February 3, 1963, we landed on the island from C.C.G.S. "Sir William Alexander", and spent the next six days observing the breeding adults and counting, sexing and marking the pups. On the west spit, a group of about 200 immature and adult seals was gathered at the western end, with a few cows and pups a little nearer the dunes. The eastern spit had a similar group of seals at the outer end with many pups, cows and bulls scattered over the whole length of the spit as far as the consolidated dunes (Figure 2). Only 12 pups were found on the western spit, though some fifty or so juvenile seals which took to the water at our approach may have been fully moulted pups. On the eastern spit we counted 270 pups. These were sexed when possible and placed into approximate age groupings based on changes in length and fatness, and state of moult (see Table 1). Figure 3 shows the predominance of group IV at Sable Island with group III predominant some ten days earlier at a colony on the Basque Islands, East Cape Breton Island. The frequency distribution suggests that the mean date of birth is about January 12, with pupping extending over a six week period from about December 23 to February 4. Of the 253 pups sexed, 122 were males and 131 females.

Breeding behaviour could not be observed in detail since most adults took to the water when approached. Fortunately, at the western end of the east spit, a long grass-covered dune gave concealed approach to a narrow beach on the north side of the island where 15 pups had been born. Eight of the 11 pups in groups I to III were accompanied by cows, and 8 large bulls were lying near enough to individual cows to suggest that monogamy is usual (Figure 4). Seven other presumably non-dominant males and three immature males were also present on the beach.

In 1964 we visited the east spit on February 8, nearly two weeks later in the breeding season than our first visit on January 26, 1962, and found that most cows had departed. A count showed 128 adult males, 21 adult females, 120 immature seals and 265 pups including 7 dead ones.

In 1965 B. Beck and I. Gidney visited Sable Island on February 10 and found that strong seas had washed over much of the east spit and few adult males and females were left. A total of 246 pups was tagged, of which 118 were males and 128 females.

It is of interest to note that grey seals wander far from their place of birth in the first year of life. In the past three years recoveries of seals tagged as pups at Sable Island have been made along the north shore of the St. Lawrence, at Anticosti Island, along the south and east coasts of Newfoundland and in the Bay of Fundy.

Phoca vitulina, HARBOUR SEAL, COMMON SEAL

In his description of the grey seal at Sable Island, Gilpin (1870) noted that "their size at once separated them from the common seal *P. bitulina* (*sic*) which constantly inhabit the island."

J. S. Erskine saw few harbour seals on his visit to the island in 1952 but noted that thousands were reported to have hauled out on the beaches in earlier times. These reports were confirmed by Dr. T. H. Raddall who told Dr. Fisher and me that harbour seals were common on the south beach at the western end of the island in the 1920's.

On our first flight over Sable Island on June 15, 1961, we saw harbour seals distributed as follows: 90 on the west spit, mostly on the south side well away from the grey seals; 15 on the north beach, and 150 scattered in groups along the south beach. From our walking trips made during the next week and the subsequent aerial survey on June 27 we were able to see that this pattern of distribution remained fairly constant. The harbour seals were never closely associated with the grey seals, except for one small group on the western spit, but remained scattered in groups of from 6 to 63, averaging 30, along the south beach opposite the consolidated dunes (Figure 1). About half of this population along the south beach remained opposite Wallace Lake and the two smaller lakes to the east, and tracks in the sand indicated that the seals frequently crossed the quarter mile from the beach to the lakes. On June 17 we counted about 100 seals in Wallace Lake, with three groups of 25, 20 and 35 on the sea beach. Smaller numbers were seen on later days until on June 27 the lake appeared to be empty of seals, though 290 were seen in groups along the sea beach. The lake is evidently a favoured pupping ground, for we found the carcasses of one new-born and two slightly older pups there, as well as a small pup with the navel not yet fully healed. On June 21 we walked along the south shore of Wallace Lake and counted 25 adult seals, 18 of which were accompanied by pups. These were easily distinguished from the adults by their small dark heads and generally inquisitive behaviour. All the pups observed were in their first hair coat, and we saw no evidence of white natal fur on the few pups which still retained part of the umbilical cord. The adults had not yet moulted and, in contrast to the dark coated pups, had light sandy coloured hair, especially when they had been hauled out for some time and the hair was dry. They were readily distinguished from the grey seals by their neater shape and more uniform size.

Out of the seven specimens taken, one pup was still suckling, and an older animal had about a litre of fish remains, probably hake, *Merluccius merluccius*, in the stomach as well as a small squid beak and pen. The other seals had empty stomachs.

We were surprised to find that harbour seals desert the island in the winter. In the course of grey seal tagging expeditions in late January and early February in the last four years, only two harbour seals have been seen. Their whereabouts at this time is unknown, but most probably they visit the nearby coasts of Nova Scotia.

Family Odobenidae

Odobenus rosmarus, WALRUS.

According to Gilpin (1870) and Allen (1880) walruses probably remained at Sable Island until the early part of the eighteenth century when oil and ivory hunters exterminated them. Remains of the animals are occasionally found, and we were shown the tusk of an old female which had been recovered from one of the beaches. It measured about 14 inches from root to tip and appeared to differ in no way from the tusks of present day walruses taken in the eastern Canadian arctic.

On February 3, 1963, while tagging grey seal pups at the end of the west spit, we found skull fragments from two walruses protruding from the sand. These consisted

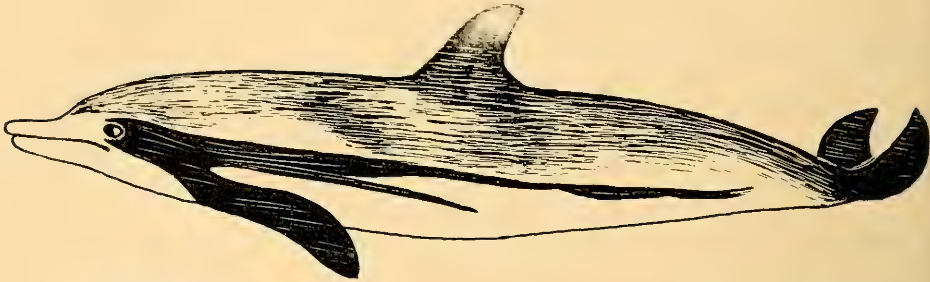

FIGURE 5. Field sketch of a stranded dolphin, probably *Stenella euphrosyne.*

of part of the cranium and the rostrum of a large male, one tusk of which had broken off in life, and an almost complete skull of a smaller animal, probably a female. The latter was unusual in possessing two small tusks in one normal-sized socket. Measurements of the skulls show them to lie well within the range of present day eastern arctic specimens. Another incomplete male skull found in 1964 proved to be slightly longer but a little narrower than the largest present day eastern arctic walrus skulls.

CETACEA

Family Balaenopteridae.

Balaenoptera musculus, BLUE WHALE.

Mr. G. MacAlpine showed us a colour transparency of a large whale approximately 85 feet long which was washed ashore on the north beach in February 1958. Its great size, when considered together with the prominent ventral grooves shown in the photograph, leave little doubt that it was a mature blue whale.

Family Physeteridae.

Physeter catodon, SPERM WHALE.

On February 6, 1964, we observed from the air a partly decomposed old male sperm whale washed up on the north beach of the east spit. We later confirmed this identification from the ground.

Family Phocaenidae.

Phocaena phocaena, COMMON OR HARBOUR PORPOISE.

On June 17, 1961, we found the carcass of a porpoise on the hard sand flat south of Wallace Lake. The small size suggested it was a young of the year. Erskine (1954) mentions seeing porpoises once at sea, and also many stranded on the south beach.

Family Delphinidae.

Globicephala melaena, PILOT WHALE, POTHEAD, BLACKFISH.

On June 20, 1961, we found the skeleton of an adult pilot whale on the north beach at about the mid point of the island. This may have been a further member of a herd of 18 whales which was stranded along a mile of the north beach near the radio station on October 2, 1959. Mr. MacAlpine showed us a transparency of one of these whales which was undoubtedly *G. melaena.*

Stenella euphrosyne, EUPHROSYNE DOLPHIN.

A stranded dolphin measuring 7 ft. long (±3 in.), with 40 teeth in each jaw, was found above high tide mark on the south side of the west spit on February 14, 1964. Though the carcass was not fresh, the colour pattern was still visible, allowing a rough sketch to be made. The dark patch extending from flipper to eye, and the bar projecting downwards from the dark horizontal stripe (Figure 5) strongly suggest a euphrosyne dolphin.

PERISSODACTYLA

Family Equidae.

Equus caballus, DOMESTIC HORSE.

The origin of the horses on Sable Island is by no means certain, though Erskine has suggested from a survey of the available literature on the island's history that they were brought from New England in 1738 when Le Mercier stocked the island with cattle. Erskine also assumes that the horses are descended from animals of normal do-

FIGURE 6. A small herd of horses at Sable Island.

mestic size which have in forty generations reverted almost to the size of their wild ancestors. In contrast to this is Dr. Thomas Raddall's opinion (*in litt.*) that the small size of the horses reflects their origin from the small Norman or Biscayan horses, some of which may have been taken to the island or even shipwrecked there by one of the many French expeditions to North America before Le Mercier's time.

The horses appeared larger than we had come to expect, and photographs of several of the wild ones taken near to one of us suggested an average adult height at the withers of about 55 inches (Figure 6). Certainly the two riding horses we saw were of this size. We also learned from past and present residents of the island that new blood had been brought in from time to time since the turn of the century. Dr. Raddall told us that in the early 1900's several stallions were brought to the island, and we also heard from one of the present observers from the meteorological station that "Colonel", a large riding stallion, had been brought to the island 30 years ago and had been allowed to run wild for some time several years ago. There seems little doubt that these recently introduced animals have contributed much to the gene pool of the island stock though genotypic increases in size may well have been offset by phenotypic effects of the environment. A rough calculation shows that the area of consolidated dunes available for grazing is about 3,300 acres, or an average of 16 acres per horse. Considering the sparseness of the plants (Figure 7), this may represent marginal feeding only. Such grazing might not allow maximal growth in size in spite of an occasional supply of baled hay provided by the Federal Government.

Colours of the horses varied from Palomino through chestnut to almost black. Some foals were actively moulting in June with the hair hanging in great shaggy patches, but most young and adults were short haired and in good condition. We found the skeleton of one foal with a hoof twisted round in a hook shape owing to uneven growth and lack of wear from the soft sand. It is doubtful whether this deformity contributed to the animal's death since we saw an adult mare with all four hooves enormously enlarged as a result of such aberrant growth. Though we were un-

FIGURE 7. Stabilised dunes with sparse marram grass, *Ammophila breviligulata*, and beach pea, *Lathyrus japonicus;* East light and the former lightkeeper's house in the background.

able to approach nearer than fifty yards, we could see that the hind hooves had turned laterally and vertically through a full circle and were beginning to spiral further. This mare seemed only slightly incapacitated by her heavy hooves and was in fact a successful mother since she was accompanied by a small foal. The only other abnormality of which we saw evidence was a malformed foreleg with the hoof twisted inwards about 120 degrees. We never saw this particular animal, but found fresh hoofprints in several places.

The total population has seldom been accurately known in the past, though Erskine's estimate of approximately 200 made in 1952 must have been near the true figure. Fortunately we were able to make detailed counts of the horses on our aerial surveys, the numbers observed being as follows:

July	1961	180
January	1962	213
January	1963	226
February	1964	199
February	1965	218

Since we might easily have missed seeing some of the horses when the two lower counts were made, the fluctuation in numbers may not be significant. Sample counts from the ground gave the proportion of foals as 15 per cent.

ACKNOWLEDGMENTS

I am grateful to Dr. H. L. Cameron of the Nova Scotia Research Foundation, Halifax, and to Dr. Thomas H. Raddall of Liverpool, Nova Scotia, for telling me much of interest about the island's history. Dr. Cameron also kindly supplied me with the original of the chart shown in Figure 1. I would also like to record my thanks to Mr. and Mrs. F. Androschuk and Messrs. G. MacAlpine and F. Burns, and other members of the staff of the radio and weather stations for their hospitality during our several visits to the island; and to B. Beck, Dr. H. D. Fisher, I. G. Gidney and T. R. Welch for their valued companionship and help while in the field.

NOTE: Under the provisions of "Regulations respecting the government of Sable Island" published under the Canada Shipping Act, 22 November 1961 (Canada Gazette Part II, Vol. 95(22): 1691) access to Sable Island is restricted, and prior permission to land there must be sought from the District Marine Agent, Department of Transport, P.O. Box 1000, Dartmouth, Nova Scotia.

REFERENCES

ALLEN, J. A. 1880. History of North American Pinnipeds. A monograph of the walruses, sea-lions, sea-bears and seals of North America. *U.S. Geol. Surv. Terr. Misc. Pub.* 12, Washington; 785 pp.

ERSKINE, J. S. 1954. The ecology of Sable Island, 1952. Proceedings of the Nova Scotian Institute of Science 23(2): 120-145.

————. 1955. Sable Island. Journal of Education, Halifax, Nova Scotia. Fifth Series, 4(2): 3-16. March, 1955.

GILPIN, J. B. 1870. The Walrus. Proceedings and Transactions of the Nova Scotia Institute of Science 2(3): 123-127.

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STATUS OF BIRDS, LAKE ST. JOHN REGION, QUEBEC

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Introduction

The Lake St. John region lies about 100 miles north of Quebec City. It is a distinct low-lying pocket of agriculture and industry, well separated from other settled areas by forest and mountain. It stretches some 100 miles from east to west and 50 miles or less from north to south.

Development of the region started about 100 years ago. It now supports a quarter million people. I have lived there, in Arvida, since 1956. When I arrived, I was surprised to find the only publication describing the birds of the region was a Bulletin of the National Museum of Canada (Godfrey and Wilk, 1948). This had been written following an expedition in the summer of 1946. It listed 133 species. As my hobby was bird-watching, I decided it would be of interest to discover the year-round status of the local birds. For seven years, most of my bird-watching was devoted to this end. Other local bird-watchers helped me. The results are given in this paper.

Method of Study

Being a mathematician by profession, I decided to describe the status of each species in terms of the average number observed per hour at different times of the year. This method I believe to be more objective than the normal verbal description: common summer resident, rare transient, etc. After all, the verbal descriptions are merely deduced from observations. My numerical summaries allow the reader to make his own deductions if he wishes.

During the period October 1, 1956 to December 31, 1963, I kept numerical records of bird-watching. Some of my friends did too, for shorter periods within the overall period. Their records are incorporated with mine. The records consisted of the number of birds of each species identified (seen or heard) each day, as well as the number of hours spent bird-watching. The final total of hours was 2,769. Of this, 1,745 hours was by me and 1,024 hours by others. The number of hours each calendar month is shown in Table 2. In all, we counted 178,726 birds of 199 species. The only species we saw and did not count was the House Sparrow.

All of this bird-watching was done in the region. At various times, we visited all parts. However, the majority of time was spent around Arvida. I have lumped records from all sections of the region together in doing my calculations, because there are not enough from outside the Arvida area to justify sub-dividing them. All the same, there are considerable differences in type of country within the region, and doubtless it will eventually be found that these have given rise to local variations in bird life. Godfrey and Wilk (1948) contains a good description of the region and a map of the western part. Arvida lies on the Saguenay River about 35 miles east of Lake St. John and just off the map.

From the daily records, I have calculated a monthly index for each of the 199 species. As mentioned, we did not count House Sparrows, so have no index for it.

CALCULATION OF MONTHLY INDEX

The index indicates the number of birds identified per hour. It takes one of the values 1, 2, 3, 4 or 5. Least common corresponds to 1, most common to 5. The symbol – means the bird was not identified at all that month.

The index is on a logarithmic scale to base 10. Thus, 5 means about 10 times as common as 4, and 4 about 10 times as common as 3, etc. So the full range from 5 down to 1 covers the ratio of about 10,000 to 1 in numbers per hour. The precise meaning of each value of the index is shown in Table 1.

TABLE 1. — Meaning of Monthly Index

Index	Birds identified per hour
5	10 or more
4	1 to 10
3	.1 to 1
2	.01 to .1
1	.001 to .01
–	not identified that month

An example, for the Canada Goose, shows the method in detail. (See Table2). In the systematic list, the twelve monthly values of the index are given on the same line as the name of the bird, thus:

Branta canadensis Canada Goose – – – 4 5 3 1 – 2 4 4 –

OTHER RECORDS IN THIS PAPER

To cater for people who prefer a linear scale to a logarithmic, I give the total number of birds counted during the whole period for each of the 199 species. It varies between 1 and 27,042. The totals add up to 178,728. They are printed on the same line as the name and the monthly indices.

Sixteen species have been recorded in the region but were not identified by us in our period of systematic observation. They are included in the list below, which thus totals 216 species.

In so many years of bird-watching, we naturally came across many items of interest which are not covered by the monthly index. These are mentioned below in notes, when they add significantly to the information in Godfrey and Wilk, 1948. They include details of:

- movements observed
- local birds
- breeding
- races identified
- specimens collected

Each note is followed by the initials of the person(s) responsible. There is a list of contributors below. The notes cover records to December 31, 1965.

TABLE 2. — Calculation of Monthly Index for Canada Goose

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Total number identified, 1956-1963	0	0	0	938	10,351	60	1	0	8	1,285	165	0	12,808
Total hours observation, 1956-1963	109	98	112	311	612	264	188	212	265	248	122	228	2,769
Average number per hour	0	0	0	3.02	16.91	0.23	.005	0	.03	5.18	1.35	0	
Index	–	–	–	4	5	3	1	–	2	4	4	–	

ACKNOWLEDGMENTS

I am grateful to many people who entrusted their records to me over the years, and who helped me in many other ways to build up a knowledge of the birds of the region. I think particularly of Mr. W. E. Godfrey, who often encouraged me by letter, identified specimens and answered queries; of Mr. W. E. Welch who spent over a year in the region as the only bird-watcher, and was the first to record many species; of Dr. W. K. Gummer, naturalist of many parts, who gave me both moral and technical support over a period of 10 years; and of my friends Mr. Don Pearson, Mr. and Mrs. D. Stokes, Mr. Derek Austin and Dr. J. P. Giguère, who freely shared their local knowledge with me.

The initials in the systematic list refer to people who made records which are notable for various reasons. Below is a list of the initials and the persons they refer to. The city following the name is the one they lived in when they made the observations. The names of persons who contributed records for the monthly index are marked with an asterisk*.

FAB	F. A. Boily, Chicoutimi, P.Q.
PB	*Peter Browne, Arvida, P.Q.
JC	*Jon Collins, Arvida, P.Q.
LC	Lormay Coulombe, Bagotville, P.Q.
CJE	Club des Jeunes Explos, St. Fulgence, P.Q.
JPG	Jean-Pierre Giguère, St. Jean Eudes, Chicoutimi, P.Q.
PKG	*Peter Gummer, Arvida, P.Q.
WEG	W. Earl Godfrey, Ottawa, Ont.
WKG	*W. K. Gummer, Arvida, P.Q.
GK	Garry Kemp, Arvida, P.Q.
AM	*Anthony Miller, Arvida, P.Q.
GM	*Gunter Moeller, Arvida, P.Q.
UM	*Uwe Moeller, Arvida, P.Q.
NR	Nelson Renouf, Kénogami, P.Q.
CT	Claude Tremblay, Chicoutimi, P.Q.
EAW	E. A. Welch, St. Félicien, P.Q.

Lastly, I would like to acknowledge a great debt to my wife and family who voluntarily deprived themselves of my company for almost all the 1,745 hours I spent bird-watching.

SYSTEMATIC LIST

Gavia immer Common Loon	– – – – 2 3 2 3 2 2 2 1,	total	165
Gavia stellata Red-throated Loon 1 on Saguenay River, 14 October 1956 (PB).	– – – – – – – – – 1 – –,	total	1
Podiceps grisegena Red-necked Grebe Seen at Arvida and Lake St. John. One shot, 27 September 1959 and wing sent to National Museum (PB, WKG).	– – – – – – 1 – 1 – – –,	total	3
Podiceps auritus Horned Grebe Seen on Saguenay River and Lake St. John. One shot and wing sent to National Museum (PB, WKG).	– – – 1 – – – – – 2 – –,	total	5

Podilymbus podiceps Pied-billed Grebe	– – – – – – 2 – 1 1 – –,	total 7
Breeds locally. Seen each summer 1960-1962, Lake Harvey (70°45′W, 48°28′N) including young 13 July 1960 (CJE). Also at Lac Bilodeau (72°10′W, 48°20′N) on 15 July 1962 (PB).		
Phalacrocorax auritus Double-crested Cormorant	– – – – 1 1 – – – – – –,	total 3
All recent sightings on Saguenay.		
Ardea herodias Great Blue Heron	– – – 2 1 – – 1 1 – – –,	total 12
No breeding evidence.		
Nycticorax nycticorax Black-crowned Night Heron	– – – – 1 2 2 1 1 – – –,	total 10
Almost certainly breeds. Present throughout summer, St. Fulgence, Arvida (CJE, PB).		
Botaurus lentiginosus American Bittern	– – – 1 2 2 2 2 2 1 – –,	total 41
Olor columbianus Whistling Swan	– – – – – – – – – – – –,	total 0
No record since 1931 (Godfrey and Wilk, 1948)		
Branta canadensis Canada Goose	– – – 4 5 3 1 – 2 4 4 –,	total 13,808
In the spring, biggest flocks occur round Lake St. John. The water level is usually low till run-off raises it about 10 May, and large sandflats are exposed at the mouths of rivers. These attract flocks of 1,000 or more. In the fall, seen mainly on fields and on tidal flats of Saguenay River. (PB)		
Branta bernicla Brant (definite)	– – – – 1 1 – – – – – –,	total 3
(probable)	– – – – 4 4 – – – – – –,	total 4,640
In late May and early June, there are large flights of geese west along the Saguenay River near Arvida. I have never seen them close enough to be quite sure, but all the clues point to Brant: small size, wavy lines rather than regular Vs, large white rump while flying away (PB). One found dead, St. Fulgence, 22 May 1965 (CT).		
Chen hyperborea Snow Goose	– – – – 3 3 – – – 4 2 –,	total 574
Mostly passing flocks (PB).		
Chen caerulescens Blue Goose	– – – – 2 1 – – – – – –,	total 22
Anas platyrhynchos Mallard	– – – 1 2 – – 1 2 1 2 1,	total 31
Mostly with Black Ducks. Wing of one, shot by hunter fall of 1960, sent to National Museum (PB).		
Anas rubripes Black Duck	– – – 4 4 3 2 4 4 4 4 3,	total 4,114
Biggest flocks on Lake St. John in spring and Saguenay in fall (PB).		
Anas strepera Gadwall	– – – – – – – 1 – – – –,	total 2
Two at St. Fulgence, 11 August 1963 (PB).		
Anas acuta Pintail	– – – 2 3 1 – 2 3 1 – –,	total 559
Anas carolinensis Green-winged Teal	– – – 2 3 1 2 2 3 3 3 4,	total 758
Anas discors Blue-winged Teal	– – – – 3 2 – 3 2 – – –,	total 157
Mareca americana American Widgeon	– – – 2 3 – 2 2 2 1 – –,	total 96
One breeding record: female with 11 unfledged young seen on lake at St. Gédéon (71°49′, 48°28′N), 29 July 1962 (PB).		
Spatula clypeata Shoveler	– – – 1 2 1 – – 1 – – –,	total 24
Pairs seen late in spring at St. Gédéon; possibly breeds (PB, WKG). One shot by hunter, 9 September 1961. Wing sent to National Museum (PB)		
Aix sponsa Wood Duck	– – – 1 1 1 2 2 2 – – –,	total 15
Probably breeds. One shot at Dolbeau, 10 September 1960. Wing sent to National Museum (PB).		
Aythya americana Redhead	– – – – 1 – – – – – – –,	total 1
One male seen, St. Gédéon, 8 May 1960 (GM). Two seen Chicoutimi, May 1965 (FAB).		
Aythya collaris Ring-necked Duck	– – – 2 2 1 – – 2 2 – –,	total 53
Aythya marila Greater Scaup Duck	– – – 1 3 1 2 – 2 3 – –,	total 131
Female scaup and 8 young, presumed this species, seen at St. Gédéon, 29 July 1962. Frequently shot in fall. Wing and head of one of these (shot 27 October 1957) sent to National Museum (PB).		

Aythya affinis Lesser Scaup Duck	– – – – – – – – – 1 – –,	total	2
Two shot by hunter, 2 October 1960 at St. Méthode Lake St. John. Wing of one sent to National Muscum (PB).			
Bucephala clangula Common Goldeneye	4 3 3 4 3 3 3 4 3 4 4 4,	total	2,773
Winter records from fast rivers, mainly below dams, which remain open.			
Bucephala islandica Barrow's Goldeneye	– – 2 2 – – – – – – – 2,	total	15
Bucephala albeola Bufflehead	– – – – – – – – – – – –,	total	0
Not seen by us. Three seen Bear River, Lake St. John, 13 May 1956 (EAW). One shot by hunter, 18 October 1958, Lake St. John. Wing sent to National Museum (PB).			
Clangula hyemalis Old Squaw	– – – – – – – – – 2 1 –,	total	9
One shot by hunter, St. Méthode, Lake St. John, 17 October 1959. Specimen sent to National Museum (PB). Seen every in September and October (WKG).			
Somateria mollissima Common Eider	– – – – 1 – 2 – – – – –,	total	5
One female on Peribonka River, 1 May 1960. Four females, Ile St. Louis (about 16 miles WNW of Tadoussac in Saguenay River), 2 July 1962 (PB).			
Melanitta deglandi White-winged Scoter	– – – – 2 2 – 1 2 1 – –,	total	37
Melanitta perspicillata Surf Scoter	– – – – – – – – 2 2 – –,	total	12
One shot by hunter, St. Gédéon, 13 October 1957. Head and wing sent to National Museum (PB).			
Oidemia nigra Common Scoter	– – – – 1 – – – – 2 – –,	total	17
One shot by hunter, Lake St. John, fall 1958. Wing sent to National Museum. Large flocks of unidentified scoters seen on Saguenay in October some years (PB).			
Lophodytes cucullatus Hooded Merganser	– – – 1 1 1 – 1 1 – – –,	total	6
Mergus merganser Common Merganser	4 3 3 3 3 3 2 2 2 3 4 3,	total	1,441
Winters same areas as Goldeneye.			
Mergus serrator Red-breasted Merganser	– – – 1 2 2 – – – 2 1 –,	total	40
One shot by hunter, St. Gédéon, 3 November 1957. Wing sent to National Museum (PB).			
Accipiter gentilis Goshawk	– – – 1 – 2 – – – – – –,	total	5
Only evidence of breeding: 3 seen together about 20 miles north of Chicoutimi, 9 June 1960 (PB).			
Accipiter striatus Sharp-shinned Hawk	– 2 – 2 1 – 1 2 2 – – –,	total	22
Winter record: 1 at Chicoutimi, 25 February 1962 (PB).			
Accipiter cooperii Cooper's Hawk	– – – – – – – – – – – –,	total	0
Reported at St. Fulgence, 5 July 1958 and 20 July 1959 (CJE).			
Buteo jamaicensis Red-tailed Hawk	– – – 2 1 1 1 1 2 1 – –,	total	22
Buteo platypterus Broad-winged Hawk	– – – 1 2 2 2 2 – – – –,	total	35
Buteo lagopus Rough-legged Hawk	– – – 2 2 1 1 1 2 2 2 –,	total	48
Summer records of this species are surprising so far south. We have three and four more have been reported by CJE.			
Aquila chrysaetos Golden Eagle	– – – – – – – – – – – –,	total	0
Only record: one seen in captivity at Chicoutimi, 1960, was taken after being shot near northern edge of Laurentide Park (PB).			
Haliaeetus leucocephalus Bald Eagle	– – – – – – – – – – – –,	total	0
One specimen in Grande Seminaire, Chicoutimi, reported shot St. Félix d'Otis (no date). This was said to be the third killed in the region (PB). Eagles believed this species seen each year about 40 miles north of Arvida (WKG).			
Circus cyaneus Marsh Hawk	– – – 2 2 2 2 2 2 2 – –,	total	91
Pandion haliaetus Osprey	– – – 2 2 2 1 2 2 1 – –,	total	92
Falco peregrinus Peregrine Falcon	– – – – 1 – – 1 1 1 – –,	total	7

Falco columbarius Pigeon Hawk – – – 2 2 – – 2 2 1 – –, total 43
Falco sparverius Sparrow Hawk – – 1 3 2 2 3 3 3 1 – –, total 290
Canachites canadensis Spruce Grouse – – – – – 1 – – – – – –, total 1
A single bird about 20 miles north of Chicoutimi, 9 June 1960 (PB).
Bonasa umbellus Ruffed Grouse 2 2 2 2 2 2 2 1 2 2 2 2, total 121
Lagopus lagopus Willow Ptarmigan – – – – – – – – – – – –, total 0
Reported by local people several winters, especially around St. Félicien and Dolbeau, but not seen by us.
Rallus limicola Virginia Rail – – – – – 1 – – – – – –, total 1
Breeding proved when adult with 3 young found at St Fulgence (10 miles east of Chicoutimi), 30 July 1959 (CJE) Heard here, 30 June 1962 (PB) Location: 70°56′W, 48°27′N
Porzana carolina Sora – – – – – 2 2 2 1 – – –, total 12
Coturnicops noveboracensis Yellow Rail – – – – – – – – – – – –, total 0
One captured, banded and photographed at St Fulgence, 25 July 1964 (CJE)
Fulica americana Coot – – – – – – – – – – – –, total 2
Two shot by hunter, Lake St John, 27 September 1958. Specimen sent to National Museum (PB) Seen at St. Fulgence, May 1965 (HAB, CT)
Charadrius semipalmatus Semipalmated Plover – – – – 3 3 2 3 3 2 – –, total 342
Like most transient shore-birds, commonest on tidal flats of Saguenay, especially at St. Fulgence The shoreline of Lake St. John is favourable only when the water is low (each year till early May, some years in late summer).
Charadrius vociferus Killdeer – – 1 3 3 3 3 2 2 – – –, total 426
Pluvialis dominica Golden Plover – – – – – – – 3 4 3 1 –, total 1,449
Large flocks (up to 270) each fall on bauxite residue ponds at Arvida. One specimen shot and sent to National Museum, 2 September 1957 (PB).
Squatarola squatarola Black-bellied Plover – – – – 2 3 – 3 3 3 1 –, total 600
Arenaria interpres Ruddy Turnstone – – – – 2 2 – 3 2 1 – –, total 140
Philohela minor Woodcock – – – – 2 – – – – 1 – –, total 17
In 1964 probably bred at Arvida. Present at least April to June (PB).
Capella gallinago Common Snipe – – – 1 3 2 2 2 2 2 – –, total 153
Numenius phaeopus Whimbrel – – – – – – – 2 – 1 – –, total 3
Actitis macularia Spotted Sandpiper – – – – 3 3 3 3 3 1 – –, total 368
Tringa solitaria Solitary Sandpiper – – – – 2 – 3 3 2 – – –, total 138
Totanus melanoleucus Greater Yellow-legs – – – 1 3 – – 2 2 2 – –, total 188
Totanus flavipes Lesser Yellowlegs – – – – 1 – 2 2 1 – – –, total 19
Calidris canutus Knot – – – – 1 2 – 2 1 – – –, total 33
Specimen collected and wing sent to National Museum, St. Fulgence, 26 August 1960 (PB, AM)
Erolia maritima Purple Sandpiper – – – – 1 1 – – – 2 2 –, total 33
Only seen on rocky shore at St. Fulgence. Specimen collected there and wing sent to National Museum, 30 October 1960 (PB).
Erolia melanotos Pectoral Sandpiper – – – – 1 – – 2 3 3 2 –, total 212
Specimen collected and wing sent to National Museum, St. Fulgence, 30 September 1957 (PB).
Erolia fuscicollis White-rumped Sandpiper – – – – 2 2 2 1 2 3 2 –, total 105
Specimen shot at Arvida and sent to National Museum, 10 August 1957 (PB).
Erolia bairdii Baird's Sandpiper – – – – – – – 2 2 – – –, total 28
Two shot at Arvida and sent to National Museum, 23 and 24 August 1957 (PB).
Erolia minutilla Least Sandpiper – – – – 3 2 2 3 2 – – –, total 371
Erolia alpina Dunlin – – – – 2 2 – 1 3 4 – –, total 353
One shot at Arvida and sent to National Museum, 6 October 1957 (PB).

Limnodromus griseus Short-billed Dowitcher – – – – 3 2 – – – – – –, total 138

Micropalama himantopus Stilt Sandpiper – – – – – – – – 1 1 – – –, total 2
Single birds at Arvida 26 August 1957 and St. Fulgence 3 September 1961 (PB).

Ereunetes pusillus Semipalmated Sandpiper – – – – 2 4 3 4 4 1 – –, total 1,167

Tryngites subruficollis Buff-breasted Sandpiper – – – – – – – – – – – – –, total 0
One seen, St. Fulgence, 20 August 1961 (CJE).

Crocethia alba Sanderling – – – – 1 2 – 3 4 3 – –, total 577

Iobipes lobatus Northern Phalarope – – – – – – – – 1 1 – – –, total 3
Single bird seen at Arvida, 12 September 1960 (AM) and 2 at St. Fulgence, 21 August 1963 (PB). Also seen St. Gédéon, 1957 (WKG)

Larus hyperboreus Glaucous Gull 2 – – 1 1 – 1 – – – 3 3, total 63
Seen annually on the Saguenay (PB).

Larus glaucoides Iceland Gull 1 – – 1 – – – – – – 1 3 3, total 62
Annual on Saguenay. Three adults (1 on 3 December 1961, 2 on 14 April 1962) seen to have grey spots on primaries were presumably of race *kumlieni* (PB).

Larus marinus Great Black-backed Gull – – – 1 – – – – – – 1 2 2, total 11
All records on or near Saguenay (AM, PB).

Larus argentatus Herring Gull 1 – 3 4 4 4 3 4 4 4 5 4, total 11,423
Breeds on islands in Lake St. John and probably other lakes. Eggs and young seen, St. Gédéon, June and July 1959 (JC). In fall, stays later on Saguenay than elsewhere because of later freeze-up (PB).

Larus delawarensis Ring-billed Gull – – – – 2 2 3 3 3 2 1 –, total 184

Larus philadelphia Bonaparte's Gull – – – – 2 2 2 2 2 1 – –, total 55
No evidence of breeding (PB).

Sterna hirundo Common Tern – – – – 1 1 3 3 2 – – –, total 68
Bred on islands in Lake St. John at St. Gédéon, 1957 (WKG).

Sterna paradisaea Arctic Tern – – – – – 4 – – – – – – –, total 700
A compact flock of about 700 at St. Fulgence on Saguenay River, 11 June 1961. Identified at close quarters (PB).

Chlidonias niger Black Tern – – – – – 1 – – – – – – –, total 2
Two with the flock of Arctic Terns, St. Fulgence, 11 June 1961 (PB).

Uria aalge Atlantic Murre – – – – – – – – – – – – – –, total 0
One, obtained from flock of about 100, St. Gédéon, Lake St. John, date unknown, in collection of LC (PB).

Zenaidura macroura Mourning Dove – – – – 1 – 2 1 – – – –, total 9
Nest found near Arvida, 1961 (JPG).

Coccyzus americanus Yellow-billed Cuckoo – – – – – – – – – – – – – –, total 0
One found dead, Bagotville, October 1964. Now in personal collection (LC).

Coccyzus erythropthalmus Black-billed Cuckoo – – – – – 1 2 – – – – – –, total 9
Song heard at St. Gédéon, June 1959 and July 1960, at Arvida July 1960 (PB, PKG, WKG).

Bubo virginianus Great Horned Owl – – – – – – – – – – – – 1, total 1
Undoubtedly more common than this record indicates!

Nyctea scandiaca Snowy Owl 3 2 – – – – – – – 1 2 2 2, total 32

Surnia ulula Hawk Owl 3 3 3 – – – – – – – 2 2 2, total 63

Speotyto cunicularia Burrowing Owl – – – – – – – – – 1 1 1 –, total 5
These five records are of the same individual which was seen at Arvida, 26 September to 7 November 1959. It occupied caverns in piles of hard mineral waste. Feathers and pellets, found inside, were identified as of this species at the National Museum (PB).

Strix varia Barred Owl – 2 – – – – – – – – – – 1, total 3

Asio otus Long-eared Owl – – – 1 – – – – – – – – –, total 2

Asio flammeus Short-eared Owl – – – 1 1 1 – 1 – – – –, total 8

Aegolius funereus Boreal Owl – 2 – – – – – – – – – –, total 1
One seen at Arvida, 9 February 1958 (GM).

Aegolius acadicus Saw-whet Owl – – – – – – – – – – – –, total 0
One, in collection LC, taken at Port Alfred, date unknown (PB).

Caprimulgus vociferus Whip-poor-will – – – – 1 – 1 – – – – –, total 2
Reported only from St. Gédéon (WKG).

Chordeiles minor Nighthawk – – – – 2 3 3 3 2 – – –, total 344

Chaetura pelagica Chimney Swift – – – – 4 4 5 5 – – – –, total 14,510
Very numerous at Arvida where there is a large roost: maximum number seen to enter: 1,150 on 30 May 1958. (PB).

Archilochus colubris Ruby-throated Hummingbird – – – – 2 2 2 3 2 – – –, total 65

Megaceryle alcyon Belted Kingfisher – – – 2 2 2 2 2 2 1 – –, total 144

Colaptes auratus Yellow-shafted Flicker – – – 3 3 3 3 3 3 2 – –, total 594

Dryocopus pileatus Pileated Woodpecker 2 2 2 2 2 1 – – – – – 1, total 28
All records from Arvida, 1957 to 1960. One specimen (undated) in collection LC from Bagotville (PB).

Sphyrapicus varius Yellow-bellied Sapsucker – – – 2 2 2 2 1 2 – – –, total 76

Dendrocopos villosus Hairy Woodpecker 3 3 2 2 2 2 1 1 2 2 2 3, total 116

Dendrocopos pubescens Downy Woodpecker 2 2 2 3 2 2 2 1 1 2 2 2, total 143

Picoides arcticus Black-backed Three-toed Woodpecker – – 1 1 1 1 2 – 1 2 1 1, total 20

Picoides tridactylus Northern Three-toed Woodpecker 1 2 – 1 1 1 – 1 – – – –, total 10

Tyrannus tyrannus Eastern Kingbird – – – – 2 3 3 3 – – – –, total 148

Empidonax flaviventris Yellow-bellied Flycatcher – – – – – 2 2 – – – – –, total 14

Empidonax trailii Traill's Flycatcher – – – – 2 3 3 3 – – – –, total 406

Empidonax minimus Least Flycatcher – – – – 3 3 3 3 2 – – –, total 268

Contopus virens Wood Pewee – – – – – 2 2 2 – – – –, total 14
Recorded at Arvida and St. Gédéon (PB, WKG, AM).

Nuttallornis borealis Olive-sided Flycatcher – – – – – 1 – 3 – – – –, total 24
Two family parties seen at Onatchiway (about 40 miles north of Chicoutimi), 18 August 1959 (WKG)

Eremophila alpestris Horned Lark – – 3 2 2 1 2 – 3 3 – 1, total 179
Birds showing the yellow eye-stripe of *E. a. alpestris*: 1 on 5 May, 4 on 11 May, 50 on 26 September, 1 on 29 September (EAW, PB).

Iridoprocne bicolor Tree Swallow – – – 2 4 4 4 3 – – – –, total 1,717

Riparia riparia Bank Swallow – – – – 3 3 4 3 – – – –, total 562

Hirundo rustica Barn Swallow – – – 1 3 2 3 3 1 – – –, total 376

Petrochelidon pyrrhonota Cliff Swallow – – – – 2 3 3 1 – – – –, total 141
Most of these records are from one colony beneath the eaves of a barn about one mile west of the mouth of the Valin River (71°00′W, 48°28′N).
There were about 12 occupied nests in 1962 and 6 in 1965 (PB).

Progne subis Purple Martin – – – – – – – – – – – –, total 0
Reported at Kénogami, 1955, 1956, 1957 (NR).

Perisoreus canadensis Gray Jay 3 2 2 1 2 – – 1 2 3 2 2, total 154
Not proven to breed in the region, though juveniles seen at Arvida 25 May 1957 and in Laurentide Park 5 June 1957 (PB).

Cyanocitta cristata Blue Jay 3 3 3 3 3 2 2 2 3 3 3 3, total 549

Corvus corax Raven 1 2 2 – 1 – 1 2 1 1 2 –, total 21
These records are mostly from low-lying and settled areas. A pair in woods at Arvida, February 1962 were possibly breeding. In the Laurentide Park, seen often (PB).

Corvus brachyrhynchos American Crow 4 4 5 5 4 4 4 4 4 4 4 4, total 12,749
Flocks frequently seen flying southwest in October at Arvida. In winter, largest numbers at garbage dumps (PB).

Parus atricapillus Black-capped Chickadee 4 4 4 3 3 2 3 3 3 3 4 4, total 1,957
Parus hudsonicus Boreal Chickadee 2 2 2 2 2 2 2 1 2 3 1 1, total 124
Five specimens collected and sent to National Museum (Arvida, 27 October, 10 and 16 November 1957, two from Lake Ha Ha, 19 April 1959) (PB).
Sitta carolinensis White-breasted Nuthatch – – – 1 1 – – – – – – –, total 3
One at Arvida 16 and 20 April 1960 was shot and specimen sent to National Museum. One seen Péribonka 6 May 1962, another at Arvida 20 November 1965 (PB, AM, GM, UM).
Sitta canadensis Red-breasted Nuthatch 2 2 1 2 2 2 2 3 2 2 2 2, total 209
Certhia familiaris Brown Creeper – – 1 2 2 2 2 1 2 2 2 2, total 56
Troglodytes aedon House Wren – – – 1 1 1 – – – – – –, total 4
Bred at Arvida up to 1955 (WKG), at Kénogami 1957 (NR) and at Arvida 1959 (PB).
Troglodytes troglodytes Winter Wren – – – 2 3 3 3 1 2 2 – –, total 215
Mimus polyglottos Mockingbird – – – – – – – – – – – –, total 0
One seen at Arvida, 1 June 1965 (PB).
Dumetella carolinensis Catbird – – – – 1 1 – – – – – –, total 3
One specimen obtained at Arvida, 4 June 1960. Sent to National Museum. In 1964, one in same area through summer till 4 August (PB).
Toxostoma rufum Brown Thrasher – – – – – 1 – – – – – –, total 1
One seen at Arvida 7 June 1958 (PB).
Turdus migratorius Robin 2 2 – 4 4 4 4 3 4 4 3 2, total 4,402
Several winter records from Arvida and vicinity of Robins feeding on Hawthorn and Mountain Ash berries. Latest, 23 February: none known to survive till spring (PB).
Hylocichla guttata Hermit Thrush – – – – 2 – 2 – 2 2 – –, total 72
Seldom found near Arvida in summer, but more common at St. Fulgence (CJE).
Hylocichla ustulata Swainson's Thrush – – – – 3 3 4 3 2 2 – –, total 639
Hylocichla minima Gray-cheeked Thrush – – – – – 2 – – 2 – – –, total 15
Several in song on Mont Valin at altitudes between 2500′ and 3200′, 8 and 9 June 1960 and 17 June 1962. (70°48′W, 48°37′N) One found dead at Arvida 30 September 1962. Two trapped and banded there 28 September 1963 (PB).
Hylocichla fuscescens Veery – – – – 2 3 3 3 2 – – –, total 278
Two, shot at Arvida 3 and 12 June 1959, sent to National Museum (PB).
Sialia sialis Eastern Bluebird – – – – – – – – – – – –, total 0
Reported in 1946 at St. Félicien (WEG) and in 1956 at St. Gédéon (including juveniles) (WKG) but not since.
Regulus satrapa Golden-crowned Kinglet – – – 1 2 1 2 2 2 2 – –, total 43
Regulus calendula Ruby-crowned Kinglet – – – 2 3 2 2 2 3 3 – –, total 47
Anthus spinoletta Water Pipit – – – – 3 – – 1 4 4 – –, total 1,53
One specimen, shot at Arvida, sent to National Museum, 9 September 1957. Large flocks seen passing overhead and on fields, marshes, spring and fall (PB).
Bombycilla garrulus Bohemian Waxwing 4 4 4 3 – – – – – – 3 4, total 1,950
Most of these records from the winters 1958-1959 and 1961-1962, when they were very common in Arvida. One, found dead, early 1959, sent to National Museum. Arrived 28 October 1965 (PB).
Bombycilla cedrorum Cedar Waxwing 2 – – – 2 4 4 4 3 2 – –, total 1,185
e only time I have known the two waxwings to be present in the region at the same time was when I saw a mixed flock at Chicoutimi, 11 January 1963 (PB).
Lanius excubitor Northern Shrike 2 – 1 2 1 – – – – 2 2 2, total 59
One, shot at Arvida, 12 October 1957, sent to National Museum (PB).

Sturnus vulgaris Starling 4 4 4 5 4 4 5 5 5 4 4 4, total 27,042

Arrives in large flocks early April. Family parties, including young, seen each year at Arvida from about 23 June (PB).

Vireo flavifrons Yellow-throated Vireo – – – – 1 – – – – – – –, total 1

One seen at St. Gédéon, May 1957 (WKG).

Vireo solitarius Solitary Vireo – – – – 2 – – 1 2 – – –, total 17

Vireo olivaceus Red-eyed Vireo – – – – 2 3 3 3 2 – – –, total 490

Vireo philadelphicus Philadelphia Vireo – – – – 2 2 2 2 2 – – –, total 41

Mniotilta varia Black-and-White Warbler – – – – 2 1 2 2 – 1 – –, total 22

Vermivora peregrina Tennessee Warbler – – – – 3 3 3 4 3 2 – –, total 606

A common breeder in coniferous forest, especially on mountains north of the Saguenay. In August, family parties swarm through the region, even in cities. (PB).

Vermivora celata Orange-crowned Warbler – – – – 1 – – – 1 – – –, total 3

Single birds 12 May 1959, 14 May 1961 and 22 September 1960 (PB).

Vermivora ruficapilla Nashville Warbler – – – – 3 3 3 2 2 1 – –, total 199

Parula americana Parula Warbler – – – – 1 1 2 – 1 1 – –, total 9

Dendroica petechia Yellow Warbler – – – – 2 3 2 1 – – – –, total 107

Disappears remarkably early in the Fall (PB).

Dendroica magnolia Magnolia Warbler – – – – 3 3 3 3 2 – – –, total 340

Dendroica tigrina Cape May Warbler – – – – 3 2 2 2 – – – –, total 114

Possibly breeds: reported through summer at St. Fulgence (CJE).

Dendroica caerulescens Black-throated Blue Warbler – – – – 2 1 – 1 1 – – –, total 12

Also reported in July at St. Fulgence (CJE).

Dendroica coronata Myrtle Warbler – – – – 4 2 2 2 4 4 – –, total 1,609

Dendroica virens Black-throated Green Warbler – – – – 2 2 2 2 2 1 – –, total 115

Dendroica fusca Blackburnian Warbler – – – – 2 2 2 1 – – – –, total 31

Dendroica pensylvanica Chestnut-sided Warbler – – – – 3 3 3 3 2 – – –, total 315

Dendroica castanea Bay-breasted Warbler – – – – 2 2 2 3 1 – – –, total 77

Dendroica striata Black-poll Warbler – – – – 2 3 – 1 1 – – –, total 109

No evidence of breeding.

Dendroica palmarum Palm Warbler – – – – – – – – – – – –, total 0

Reported near St. Félicien, June-July 1956 (EAW). One at Arvida, 4 September 1965 (PB).

Seiurus aurocapillus Ovenbird – – – – 3 3 3 1 1 – – –, total 181

Seiurus noveboracensis Northern Waterthrush – – – – 3 3 2 2 1 – – –, total 125

Oporornis philadelphia Mourning Warbler – – – – 2 3 3 3 1 – – –, total 244

Geothlypis trichas Yellowthroat – – – – 3 3 4 3 3 2 – –, total 854

Wilsonia pusilla Wilson's Warbler – – – – 2 2 2 2 2 – – –, total 103

Wilsonia canadensis Canada Warbler – – – – 2 3 3 3 1 – – –, total 113

Not as common as found by WEG.

Setophaga ruticilla American Redstart – – – – 3 3 3 3 2 1 – –, total 601

Passer domesticus House Sparrow ? ? ? ? ? ? ? ? ? ? ? ?, total ?

Not regularly counted. Present every month. In winter, most leave towns for barns, where they live with stock.

Dolichonyx oryzivorus Bobolink – – – – 1 2 2 2 – – – –, total 35

Breeds quite commonly near St. Fulgence, by Saguenay River (70°56′W, 48°27′N) (PB).

Sturnella magna Eastern Meadowlark – – – 1 2 2 2 2 – – – –, total 72

Most records from Arvida and St. Fulgence. Certainly breeds. One recently fledged young found at Arvida, 10 July 1958 (71°10′W, 48°25′N) (JC, PG, PB).

Agelaius phoeniceus Red-winged Blackbird – – – 3 3 3 4 4 4 4 – –, total 5,211

Euphagus carolinus Rusty Blackbird – – – 2 3 1 3 3 3 4 – –, total 1,145

Recorded most swampy wooded areas. Flocks with Redwings in fall. One specimen shot at Arvida 3 August 1957: sent to National Museum (PB).

Quiscalus quiscula Common Grackle 1 2 – 3 3 3 3 3 3 2 – –, total 862
Winter records from Arvida city dump (PB) and Chicoutimi (HAB, CT).

Molothrus ater Brown-headed Cowbird – – – 3 3 3 3 2 2 2 1 1, total 1,006
Frequently mixes with Starlings, especially spring and fall. Juveniles seen mid-July to mid-August. Hosts: Redstart, Magnolia Warbler, Slate-colored Junco, and Swamp Sparrow (PB).

Piranga olivacea Scarlet Tanager – – – – 1 2 – – – – – –, total 19
Seen at and near Arvida several summers (males only) (PB).

Pheucticus ludovicianus Rose-breasted Grosbeak – – – – 1 2 2 1 1 – – –, total 13
No evidence of breeding (PB).

Passerina cyanea Indigo Bunting – – – – – – – 1 1 – – –, total 2
Several records in July, 1964 and 1965 at Arvida and Val Jalbert (PB, CJE).

Hesperiphona vespertina Evening Grosbeak 4 4 4 4 4 3 3 3 3 4 4 4, total 5,839
Almost certainly breeds: flying young in families seen at St. Gédéon and St. Fulgence several summers since 1957. Comes readily to feeders with sunflower seed at Arvida in winter, especially since 1960. Many banded since 1963. About 4-5% of those caught have been banded elsewhere (east to New Brunswick, south to Virginia, west to Wisconsin). Recoveries have come from east to New Brunswick, south to North Carolina, west to Kenora, Ontario, but few in following winters in Arvida. Males predominate (70-80% of those trapped) in winter (PB).

Carpodacus purpureus Purple Finch – – – 3 4 3 3 3 3 2 – –, total 1,215

Pinicola enucleator Pine Grosbeak 4 4 2 1 1 – – 1 – 3 3 4, total 600
Other summer records in June and July 1958-9 at St. Fulgence (CJE). In winter, very numerous in cities on Mountain Ash. Specimen, collected at Arvida 29 October 1957, sent to National Museum. (PB).

Acanthis hornemanni Hoary Redpoll – – 2 2 – – – – – 2 2 –, total 28
All these were sight records (PB, JC, PKG, NR). Also reported St. Félicien, 6 and 13 April 1956 (EAW).

Acanthis flammea Redpoll 4 4 4 5 3 – – – – 4 4 4, total 8,510
Reported 8 and 29 July 1959 at St. Fulgence (CJE). One specimen collected at Arvida 20 October 1957 and sent to National Museum. Of 110 banded Arvida, 18 March - 9 April 1963, 102 had wing length (chord) in range 70-79 mm. and 8 in range 80 - 83 mm., forming bimodal distribution. Presumably they were of two races: *linaria* (smaller) and *rostrata* (larger) (PB, JPG).

Spinus pinus Pine Siskin – – – – 3 3 3 4 4 3 – 2, total 1,428

Spinus tristis Common Goldfinch – – – 2 3 4 4 3 4 3 2 –, total 1,682

Loxia curvirostra Red Crossbill 2 – 2 – – – – – – – – –, total 12
All seen at Arvida in 1960. Two specimens (male & female) shot on 6 March 1960 sent to National Museum. They had not yet bred that year. Identified as *L. c. pusilla*. (WEG, PB).

Loxia leucoptera White-winged Crossbill 3 3 – 2 – – 3 1 1 – 2 3, total 269

Passerculus sandwichensis Savannah Sparrow – – – 2 3 3 3 3 3 2 – –, total 1,030

Passerherbulus caudacutus Leconte's Sparrow – – – – – – 2 2 – – – –, total 6
Pair bred at St. Fulgence (70°56′W, 48°27′N), 1963. Seen by several observers, photographed, one adult and one juvenile banded, 20 July to 11 August 1963 (CJE, PB).

Pooecetes gramineus Vesper Sparrow – – – – 2 2 – 2 1 2 – –, total 28

Junco hyemalis Slate-colored Junco Winter records refer to one bird which came to feeder in Arvida, 13 December 1961 to 6 January 1962 (GK).	2 – – 4 4 3 3 3 4 4 – 2,	total 3,731
Spizella arborea Tree Sparrow Winter records at Arvida: single birds 18 &25 February and 23 December 1962. One shot 5 October 1957 sent to National Museum (PB).	– 2 – 3 3 1 – – 2 4 2 1,	total 1,625
Spizella passerina Chipping Sparrow	– – – – 3 3 3 3 3 2 – –,	total 698
Zonotrichia leucophrys White-crowned Sparrow Male shot at Arvida 21 September 1957 sent to National Museum (PB).	– – – – 4 2 – – 3 3 – –,	total 531
Zonotrichia albicollis White-throated Sparrow	2 – – 3 4 4 4 3 3 3 – 2,	total 2,801
Passerella iliaca Fox Sparrow Seen at St. Felicien May 1956 (EAW) and at Arvida by several observers (PB, AM, GM).	– – – 1 2 – – – 1 2 – –,	total 27
Melospiza lincolnii Lincoln's Sparrow	– – – – 3 3 3 2 3 2 – –,	total 258
Melospiza georgiana Swamp Sparrow	– – – 1 3 2 3 2 2 – – –,	total 166
Melospiza melodia Song Sparrow Winter records all refer to one bird which came to feeder in Arvida 14 December 1960 to 18 February 1961 (PB).	2 2 – 4 4 4 4 3 3 3 – 2,	total 2,795
Calcarius lapponicus Lapland Longspur Seen in May at Péribonka, in fall at Arvida and St. Fulgence. One shot there, 29 October 1961 and sent to National Museum (PB).	– – – – 2 – – – 2 2 2 –,	total 62
Plectrophenax nivaiis Snow Bunting Largest flocks seen April-May and October, especially in fields around Lake St. John. (EAW, PB). One specimen sent to National Museum: 25 October 1959 (PB).	3 3 4 4 4 – – – – 4 5 4,	total 7,988

REFERENCE

GODFREY, W. EARL, and A. L. WILK. 1948. Birds of the Lake St. John Region, Quebec. National Museum of Canada, Bulletin No. 110.

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FUNCTIONAL ANATOMY OF THE TAIL AND ASSOCIATED BEHAVIOR IN WOODLAND CARIBOU

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MANY studies have been devoted to behavioral aspects of caribou and some have been devoted to anatomy. However, a correlation between the two, especially with regards to olfaction, is rarely encountered.

It is known that caribou communicate socially by both visual and olfactory means. Lent (1964, p. 167) even suggests that olfactory stimuli are the more important of these two alarm mechanisms. The preorbital, tarsal and interdigital glands are known to be well developed and function to secrete odoriferous material (Quay, 1955), but the nature and associated function of the tail has not been described.

Three caribou were collected on December 3, 1962 at the headwaters of Rock Creek, three miles north of Jasper National Park, Alberta. The taxonomic status of this population is referred to by Banfield (1961) as *Rangifer tarandus caribou* (Gmelin). These specimens were prepared as complete skeletons and skins for the University of Alberta Museum of Zoology and consist of the following: A mature bull (UAMZ 3759) weighing 300 pounds; a mature cow (3760) weighing 225 pounds; and a female calf (3761) weighing 122 pounds.

While preparing the specimens it was noticed that the tail of all three animals had a pungent, musky odor which was associated with a brownish-yellow stain. This odoriferous material stained about three-quarters of the distal end of the tail. This yellowish exudate on the white under-tail hairs occurred as a band which varied from 15 to 30 mm in width (Figure 1). These findings suggested that a large portion of the tail contained scent glands which might function for olfactory communication in conjunction with the visual tail-raising process often witnessed when caribou are alarmed.

The following table compares the extent of staining on the three animals.

TABLE 1. — Portion of distal tail surface stained by glandular exudate.

Specimen	Sex and Age	Tail Length (mm)	Stain Length (mm)	% of Length Stained
No. 3759	Male Adult	160	110	68.7
No. 3760	Female Adult	150	100	66.6
No. 3761	Female Calf	100	80	80.0

Skin samples were taken from the adult female from a portion of the tail associated with the exudate and from an area in the perinal region where no glandular secretion was evident. This tissue was fixed in Sousa's solution and vertical sections were made at 10 microns. These were then stained with Ehrlich's hematoxylin and counter stained with eosin Y.

Figure 1 clearly shows the position of the sebaceous glands which lie adjacent to and secrete into the basal portion of the hair follicle. These glands are present in skin from both regions. However, the thick layer of apocrine gland tubules, which lie under the sebaceous glands, are only present in tissue associated with the stained distal tail region. Serial sections of this tissue show that the excretory duct from these deep apocrine glands empties its exudate through funnel-like orifice at the base of the hair above the opening of the sebaceous glands.

According to Trautmann and Fiebiger (1952) the secretion of apocrine glands is a fatty substance and some apocrine skin glands are known to produce odoriferous substances. Associated are the arector pili muscles which serve both to erect the hair and force secretion from these glands.

The extensive nature of these odoriferous glands and their association with a possible muscular control mechanism strongly suggests their use for social communication.

Sheldon (1960) describes the behavior of alarmed caribou in Alaska as follows: "The cows in the meanwhile had come in my wind, when up went all their tails and with great jumps they circled and ran about in confusion." Similar behavior was observed by O'Connor (1961) who described caribou in the mountains of western Alberta. O'Connor, who was seated on a hillside with a companion, remarked that when the cows sighted them they "made a circle until they caught our wind. Then they jumped into the air, hoisted their tails, and took off at a high trot. The big bull had been watching them, and when he saw those tails go up he also started off." Similar behavior patterns were observed by De Vos (1960) studying barren ground caribou in the Northwest Territories. Lent (1964) elaborately describes visual and olfactory alarm reactions, concluding that alarm reactions were greater when stimulated by odor than by sight. In comparing alarm reactions illicited by visual versus olfactory stimuli he remarks that, "If one individual shows an alarm pose or starts to flee, it has little effect on the mass of others around it. Little attention is paid to the rapid movement of one or even a few individuals. . . . A different situation may arise with regard to alarming olfactory stimuli. In this case a great proportion of the individuals, even in a large aggregation, may receive the alarming stimulus simultaneously. Thus fright reactions can easily spread throughout an entire group." Shaposhnikoff (1941) who studied Altai reindeer behavior in Russia states that, "When suddenly frightened reindeer always make a circle, running to the lee of the object which startled them." Stelfox, in 1962, noticed similar behavior in caribou of the Smoky River region of western Alberta. On this occasion a calf and a yearling led by a cow sighted the observer when they were up wind. While the observer remained motionless they trotted, with tails erect, in a semi-circle until they were down wind of the observer at which time they took flight in a straight line.

It has been shown then that normal alarm behavior in caribou includes tail erection which is often accompanied by a circling movement. This characteristic behavior implies a two fold alarm mechanism, visual as well as olfactory.

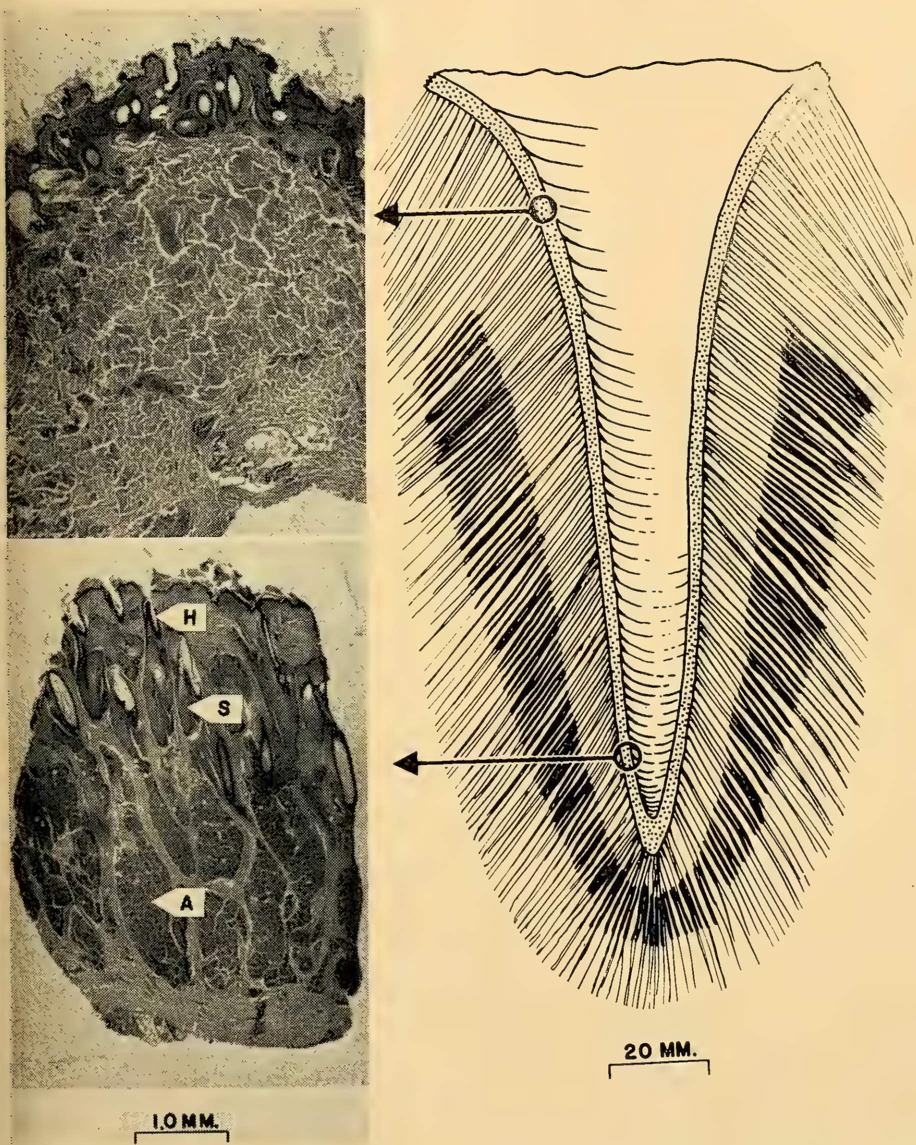

FIGURE 1. The tail and its associated glands in the woodland caribou. RIGHT: Extent and position of exudate on under-tail hairs (in heavy black) and locations from which tissue samples were obtained (circles with arrow). UPPER LEFT: Vertical section of skin from perianal region showing relation of sebaceous glands to hair follicles. Note the lack of apocrine glands. LOWER LEFT: Vertical section of skin from distal tail region. Note the abundant apocrine glandular tissue. A — apocrine gland tubules. S — sebaceous gland. H — hair follicle, note opening of apocrine duct.

The effectiveness of the scent to alarm other caribou would thus be enhanced by any circular movement as opposed to flight in a straight line.

Thus the tail not only serves as a visual signal, as previously supposed, but it also seems to act as a scent brush to disseminate an alarm producing substance.

REFERENCES

BANFIELD, A. W. F. 1961. A revision of the reindeer and caribou, genus *Rangifer*. National Museum of Canada, Bulletin 177, 137 pp.

DE VOS, A. 1960. Behavior of barren ground caribou on their calving grounds. Journal Wildlife Management. 24:250-258.

LENT, P. C. 1964. Calving and related social behavior in barren-ground caribou. Unpublished Ph.D. thesis, University of Alberta Library, Edmonton, 220 pp.

O'CONNOR, J. 1961. The big game animals of North America. E. P. Dutton and Co. Inc., N.Y. 264 pp.

QUAY, W. B. 1955. Histology and cytochemistry of skin gland areas in the caribou, *Rangifer*. Journal of Mammalogy, 36:187-201.

SHAPOSHNIKOFF, F. D. 1941. Ecology and morphology of the Altai reindeer. Department of Game Preserves and Hunting, U.S.S.R., Ministry of Agriculture, 23 pp. translated by J. M. MacLennan, Canadian Wildlife Service.

SHELDON, C. 1960. The wilderness of Denali. Charles Scribner's Sons. N.Y. 412 pp.

TRAUTMANN, A., and J. FIEBIGER. 1952. Fundamentals of the histology of domestic animals. Comstock Publishing Associates, Ithaca, N.Y. 426 pp.

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NINTH CENSUS OF NON-PASSERINE BIRDS IN THE SANCTUARIES OF THE NORTH SHORE OF THE GULF OF ST. LAWRENCE

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In 1925 ten bird sanctuaries were established on the north shore of the Gulf of St. Lawrence by the then Department of the Interior of the Canadian Government. The sea birds nesting on the many islands which fringe that shore had been persecuted so that their numbers had rapidly dwindled. To evaluate the effects of the protection given to those birds, a census has been conducted every five years by the Canadian Wildlife Service and the results have all been published in *The Canadian Field-Naturalist* (Lewis, 1925, 1931, 1937, 1942; Hewitt, 1950; Tener, 1951; Lemieux, 1956; Moisan, 1962).

The ninth census was conducted by the authors from June 14 to June 25, 1965. The cruise from Gaspé to Blanc Sablon, Quebec, and return took place aboard the Royal Canadian Mounted Police ship "Wood". The co-operation of the commanding officer, Inspector Roberts, and of the crew was again outstanding. Exceptionally good weather prevailed during the trip so that the census was completed in record time.

As in previous censuses, the procedure followed was that described by H. F. Lewis. Only birds actually seen were counted, except for the Common Puffins on Perroquet Island in which case the number of occupied burrows was carefully checked. In Wolf Bay Bird Sanctuary, Razor-billed Auks and Puffins were so numerous that an estimate had to be made which might be termed rather subjective. However, it is felt that the results of the 1960 and 1965 censuses are comparable, as both surveys were conducted by the same person (senior author) in the same manner. Since no attempt was made to guess the number of birds away fishing, the figures listed in Table 1 constitute a conservative estimate.

The nesting season appeared to be late in 1965 and many birds which are not local nesters such as Brant, the three species of scoters, and Common Loon were often seen in the sanctuaries. These birds are not included in Table 1.

A slight increase (10 per cent) in the total number of birds was found but the increase did not apply to each species. There was no significant change observed in the total numbers of Red-throated Loon, cormorants, Black Duck, Pintail, Green-winged Teal, Red-breasted Merganser, Semipalmated Plover, Spotted Sandpiper, Razor-billed Auk, and Black Guillemot. A decrease was noted in Common Eider, Great Black-backed Gull, Ring-billed Gull, Caspian Tern, and Common Murre. Herring Gull, Kittiwake, Common and Arctic Terns, and Puffins showed an increase. The conditions of the sanctuaries varied: some were in excellent condition, some appeared to have deteriorated, and others showed no visible change.

TABLE 1. — Census of Non-passerine birds in the bird sanctuaries of the North shore of the Gulf of St. Lawrence 1960-1965

Species	Caroussel Island		Birch Island		Bet-chouane		Watshishu		Fog Island		Wolf Bay		St. Mary Islands		Mecatina		St. Augustin		Bradore Bay		TOTALS	
	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965
Red-throated Loon									3	15	10	2	8	15	8	8	22	6			51	46
European Cormorant													555	365							555	365
Double-crested Cormorant	200	230	12	14			250	270			101	0	0	210							563	724
Black Duck			13	6	0	3			2	10			2	0	4	0					21	19
Pintail			2	6	1		3	2	0	3											6	11
Green-winged Teal	0	2							0	2			5	2			0	1			5	7
Common Eider	172	210	2025	725	705	1040	1492	2910	985	575	1620	980	2650	1000	263	200	1120	335	0	4	11032	7979
Red-breasted Merganser	1		3						3	2					0	3					7	5
Semipalmated Plover							0	2	5	4			7	10			1	1	2	2	15	19
Spotted Sandpiper			0	8	10	7	21	9	36	5	7	4	28	15	2	0	0	7	10	12	114	67
Great Black-backed Gull	7	60	64	95	62	50	310	102	295	215	494	270	405	575	114	110	145	115	0	2	1896	1594
Herring Gull	2410	7000	1200	3100	850	1200	165	170	55	125	1200	1100	1585	1400	387	460	3080	3760			10932	18315
Ring-billed Gull					500	150			135	150	466	0					1300	0			2401	300
Black-legged Kittiwake	249	380	250	275	0	25															499	680
Common and Arctic Terns			260	160	3	3	560	1490	162	45	82	35	230	40	44	35					1341	1808
Caspian Tern									45	10											45	10
Razor-billed Auk	34	100			315	390	33	29	49	40	9240	11000	5450	1675	0	16			1100	1700	16221	14950
Common Murre					0	25					1075	1000	10570	6120					150	5	11795	7150
Black Guillemont	125	165	40	3			17	23	136	200	14	18	390	375	184	73	114	50		1	1020	908
Common Puffin			1		205	430			7	18	11240	12500	4840	1325					7180	21000	23473	35273
TOTALS	3198	8147	3870	4392	2651	3323	2851	5007	1918	1419	25549	26909	26725	13127	1006	905	5782	4275	8442	22726	81992	90230

Caroussel Island Bird Sanctuary in the Bay of Seven Islands was in excellent condition. The total number of birds had more than doubled since 1960, the increase being mainly due to the fantastic proliferation of Herring Gulls. These birds were nesting all over the island and the hatching success was the highest observed in the North Shore Sanctuaries. Common Eider, Kittiwake, Razor-billed Auk, and Guillemot are also increasing. All molestation has ceased due to the caretaker's diligence and the sanctuary is beginning to attract the residents of Seven Islands who visit the area to enjoy the bird-life.

In the Birch Islands Bird Sanctuary at Mingan, the main features were the drastic diminution of the Common Eider breeding population (65 per cent) and the augmentation of the Herring Gull population. The Herring Gull population, which in 1925 was estimated at 60, had reached more than 3,000 birds.

No important change was observed in Betchouane Sanctuary. There was a significant increase in the numbers of Common Eider, Herring Gull, Razor-billed Auk, and Common Puffin. A small colony of Murres has appeared as well as a small group of Black-legged Kittiwakes but the Ring-billed Gull colony has dwindled from 500 to 150 individuals.

In Watshishu Sanctuary the Common Eider population has doubled and the terns tripled since 1960. The gull population has remained low and other species showed no appreciable change.

Fog Island Sanctuary appeared to have deteriorated. Common Eiders were reduced in number as were the terns. It was disturbing to note that the Caspian Tern colony, which had numbered between 60 and 95 individuals since 1925, was down to five pairs in 1965. This species is not known to nest elsewhere in the sanctuaries or even in the Province of Quebec.

In Wolf Bay Sanctuary, the cormorant and the Ring-billed Gull colonies had disappeared, and Common Eiders were less numerous than previously. Razor-billed Auk and Puffin were so numerous that any precise count would have been impossible to carry out in the short time we spent in the area. The estimate in Table 1 was based on information supplied by Mr. Henry Jones, who has been caretaker of this sanctuary for more than 25 years.

The sharp decrease noted in the numbers of Razor-billed Auks, Murres, and Puffins in St. Mary Islands Sanctuary may be less serious than it appears since we did not account for birds away fishing. The weather conditions were ideal when the census was made and many birds were undoubtedly away from the islands. A significant drop was also observed in the terns and Common Eiders. The appearance of 200 Double-crested Cormorants and the fact that the total number of cormorants did not change suggest that all cormorants were probably, and erroneously, identified as European Cormorants in 1960. This sanctuary remains one of the most interesting along the North Shore.

The Mecatina Sanctuary continues to be poor. In 1925, it was estimated by Lewis (1925) that 962 birds were breeding on the 138 islands; in 1965, we counted 905. Egging and shooting may be responsible since the sanctuary is located between two fair-sized communities.

The striking features in St. Augustin Sanctuary were the sharp drop in Common Eider numbers (70 per cent), the disappearance of a large Ring-billed

Gull colony, and the fact that nearly all Herring Gull nests had been robbed. On one island occupied this year by 2,500 gulls, only 25 eggs were counted in 250 nests found at random. This area has always been known for its eggers.

In Bradore Bay Sanctuary, the Common Puffins, which numbered about 50,000 since 1925 but only 7,000 in 1960, are increasing: they were estimated at 21,000 in 1965.

In summary, it is probable that most of the variations encountered in comparing 1960 and 1965 data were within the margin of error inherent in the method of censusing. However, the increase in Herring Gulls and the decrease in Common Eiders were undoubtedly real. The drop in the number of Ring-billed Gulls was probably due to the peculiar habit of this species of shifting breeding sites every few years, especially when disturbed. Arctic and Common Terns behave the same way and their increase might be similarly explained. The fine recovery of the Common Puffin population at Perroquet Island in Bradore Bay Sanctuary is encouraging as is the increase of birds on Caroussel Island. In general, the avian populations appear to have maintained themselves reasonably well, particularly in the areas where depredations seem to be at a minimum.

REFERENCES

HEWITT, O. H. 1950. Fifth census of non-passerine birds in the sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 64: 73-76.

LEMIEUX, L. 1956. Seventh census of non-passerine birds in the bird sanctuaries of the North Shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 70: 183-185.

LEWIS, H. F. 1925. The new bird sanctuaries in the Gulf of St. Lawrence. Canadian Field-Naturalist 39:177-179.

———, 1931. Five years' progress in the bird sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 45:73-78.

———, 1937. A decade of progress in the bird sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 51:51-55.

———, 1942. Fourth census of the non-passerine birds in the bird sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 56: 5-8.

Moisan, G. 1962. Eighth census of non-passerine birds in the bird sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 76: 78-82.

Tener, J. S. 1951. Sixth census of non-passerine birds in the bird sanctuaries of the north shore of the Gulf of St. Lawrence. Canadian Field-Naturalist 65: 65-68.

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REPORT OF COUNCIL TO THE EIGHTY-EIGHTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 6, 1966

During the past year, four meetings of Council were held at the National Museum of Canada: December 16, 1965, March 12, October 14 and November 22, 1966. The average attendance was twelve members. The Club's business was conducted in the usual orderly manner.

Appointments for 1966 were made as follows:

Editor, The Canadian Field-Naturalist	— F. R. Cook
Business Manager, The Canadian Field-Naturalist	— W. J. Cody
Chairman, Publications Committee	— J. M. Gillett
Chairman, Excursions and Lectures Committee	— H. N. MacKenzie
Chairman, Reserve Fund Committee	— H. Lloyd
Chairman, Membership and Public Relations Committee	— F. H. Schultz
Chairman, Bird Census Committee	— G. H. McGee
Chairman, Macoun Field Club Committee	— I. Brodo
Chairman, F.O.N. Affairs Committee	— Miss V. Humphreys
Chairman, Sites Committee	— W. K. W. Baldwin
O.F.N.C. Representative to A.A.A.S. Council	— V. E. F. Solman

Report of the Publications Committee

Since the last report of Council, four numbers of The Canadian Field-Naturalist have been published. These include Volume 79, Number 3, July-September, containing 60 pages and Number 4, October-December, containing 56 pages; Volume 80, Number 1, January-March, containing 62 pages and Number 2, April-June, containing 56 pages. The breakdown of articles by subject for the four numbers is as follows:

	PAPERS	NOTES	REVIEWS
Botany	6	0	2
Entomology	2	0	0
Herpetology	0	3	0
Ichthyology	2	0	2
Mammalogy	5	0	2
Ornithology	7	14	3
Miscellaneous	6	1	11
	28	19	20

The editor has reported that Volume 80, Numbers 3 and 4 will be published before the end of the year. Adequate manuscripts are on hand for at least the first number of Volume 81.

Expenditures for the year were as follows:

Volume 79 (Nos. 3 and 4) and Volume 80 (Nos. 1 and 2)	$3,841.74
Reprints for Volume 79 (Nos. 2, 3 and 4)	927.23
Total	$4,768.97

The publication of The Canadian Field-Naturalist was again supported this year by a grant of $500 from the Conservation Committee of the Canadian National Sportsmen's Show. This assistance is gratefully acknowledged.

Our editor, Mr. Francis Cook has announced his intention to resign at the end of his current term. The Publications Committee would like to extend our thanks to Mr. Cook for his invaluable service he has rendered the Club and THE CANADIAN FIELD-NATURALIST in his capacity as editor.

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

The Committee met five times during 1966 and five issues of the Newsletter were released. Gatineau Park was chosen as the focus of the season's outings with eleven field trips covering birds, frogs, flowers, beaver, ferns, insects and geology. In addition, four outings to the Shirley Bay—Watt Creek sanctuary, where a great variety of shore and water birds were observed, three morning bird walks to Vincent Massey Park, and a Woodcock singing ground visit, were arranged. Indoor activities included three study sessions on wild plants, an evening to review and study warbler songs and the "members film night".

The annual dinner was attended by some 85 Club members and guests who took a trip to Mexico with Ed. Greenwood who illustrated his talk on Mexican Wildflowers with his excellent slides.

The newsletter contained several items intended to help members to be better aware of their Club and its activities. These included *Council Reports*, two articles by Ted Mosquin entitled *Frontiers in Conservation*, a report on the *Gatineau Park Committee* and Vi Humphrey's report on the *Federation of Ontario Naturalists*.

The E. and L. Committee hopes that this has been an interesting year for members. We can assure you that it has been an interesting year for us. Our sincere thanks go to those who supported us by acting as leaders and co-ordinators of the meetings, study groups and outings. We also thank those who made the effort worthwhile by turning out and supporting us with their interest. The committee continues to have a need for constructive criticism, suggestions, ideas and leaders and will welcome any such contributions from members.

REPORT OF THE RESERVE FUNDS COMMITTEE

The only business dealt with was the purchase of two shares of Bell Telephone Co. stock utilizing 28 of 33 rights received. The total amount invested was $76.00. Funds remaining in the Reserve Funds amount to $386.15 and consideration should be given to further investment as soon as the sum available exceeds $500.00.

REPORT OF THE BIRD CENSUS COMMITTEE

The Club's forty-seventh consecutive annual Christmas Bird Count was held on Monday, December 27, 1966.

A total of 8367 birds of 52 species were reported compared to 6754 birds of 45 species in the previous year. The number of individuals is well above the 10 year average of 6182 and equals the second high of 52 reached in 1963. Two new species, Oregon Junco and Field Sparrow, were added to our all time list which now totals 94 species.

A total of 51 observers in 13 parties participated.

The results of the count were reported to the National Audubon Society and have been published in the *Audubon Field Notes*. The results were also published in the February 1966 Newsletter and were made available to the

Kitchener-Waterloo Club for inclusion in a tabulation covering some 26 clubs in Ontario.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

The Macoun Field Club suffered a severe loss in the untimely death of its Director, Alfred Ellis. While not trained in science he was, by temperament and by previous experience, well qualified for leadership of youth, and was entering his new duties with zest.

Other losses during the year were Gaston Tessier, who joined the Canadian Wildlife Service, and Stewart MacDonald who left early for field work in the West. Finally, Hugh Thompson of the Museum Education Office exchanged that position for a teaching appointment. Fortunately, Mike Shcheponek and Irvin Brodo, both of the Museum Botanical staff, had been recruited and have made themselves well at home. Mr. Shcheponek has organized a fine lending library out of the contributions of the Kiwanis Club and the books already donated by Mr. Maddox, Dr. Snure and from the library of Dr. DeLury, and various other sources, including members. Dr. Brodo is very efficiently directing the Club with valued co-operation from Mr. Hopton from the Education Office. It fell to Mr. Hopton to see the Little Bear through after Mr. Groh departed for duties at Boys' Camp.

The Club was represented at O.F.N. Club dinner by the usual exhibit of work and specimens, and by its President, Robbie Sprules at the head table, and by other member guests, only one of many favours during the year, including addresses, out-trips to Morrisburg, Lusk Falls and into the Gatineau.

Indoor program included some fifteen addresses by specialists, often illustrated, besides a few by High School members, and other pictures for the Saturday morning groups.

Presidents elected for the current season (with supporting Executives) are: High School; Robert St. Clair; Intermediate, Peter Teal; Junior, Jill Merrill.

REPORT OF SITES COMMITTEE

No formal meetings of the committee were held during the year. However, the chairman spent considerable time with officers of the National Capital Commission advising on the Mer Bleue project. The Committee on Gatineau Park was also active and made progress in designating areas for preservation.

REPORT OF THE MEMBERSHIP AND PUBLICITY COMMITTEE

As of November 30, 1966, the membership consisted of

Patrons	2
Honorary	5
Life	11
Affiliated Societies	10
Active	728
Associate	28
Total	784

Plans were initiated to produce a brochure highlighting the natural history features of the Ottawa district. It is planned to have the brochure available for visitors to Ottawa during Centennial Year.

The usual fine co-operation of the local newspapers was enjoyed.

A. W. RATHWELL, *Secretary*

STATEMENT OF FINANCIAL STANDING
THE OTTAWA FIELD-NATURALISTS' CLUB 30 NOVEMBER 1966

CURRENT ACCOUNT

Assets

Balance in Bank 30 Nov. 1966		$ 7,264.74
Bills receivable		250.19
		$ 7,514.93

Liabilities

Cheques Outstanding	$ 10.00
Balance	7,504.93
	$ 7,514.93

Receipts

Bank Balance Nov. 30, 1965		$ 6,667.19
Fees: Current	$3,236.03	
Arrears	170.00	
Advance	574.13	
Associate	81.00	
		4,061.16
Separates & Illustrations		1,969.69
Back Numbers		760.24
Geology Papers		63.25
Donation: Sportsmen's show		500.00
Macoun Club collection		21.80
Sale of Christmas cards		17.50
Miscellaneous		289.15
		$14,349.98

Expenditures

Canadian Field-Naturalist (5 nos)		$ 5,094.93
Separates & Illustrations		927.23
Editor's Honorarium		200.00
Business Manager's Honorarium		100.00
News Letter		66.73
Macoun Field Club		168.33
Clerical assistance for Treasurer		29.60
Postage & Stationery		126.40
Bank Discount		45.35
Miscellaneous		336.67
Balance in Bank 30 Nov. 1966	$7,264.74	
Less o/s Cheques	10.00	
		7,254.74
		$14,349.98

RESERVE FUND

Assets

$3,000 Ont. Hydro 3% Bonds, Market value	$ 2,800.75
30 Shares Bell Telephone Stock, Market value	$ 1,380.00
Bank Balance 30 Nov. 1966	388.85
	$ 4,569.60

Liabilities

Nil

Receipts

Balance in Bank 30 Nov. 1965	$ 301.68
Bank Interest	9.67
Ontario Hydro Bond Interest	90.00
Bell Telephone Dividends	68.55
Sale of 5 Bell Telephone rights	2.70
	$ 472.60

Expenditures

Saftey deposit box rent	$ 5.00
Purchase 2 Shares Bell Telephone	76.00
Transfer Bell Telephone Dividend to Publication fund	2.75
Balance in Bank 30 Nov. 1966	388.85
	$ 472.60

PUBLICATIONS FUND

Assets

$1,500 Ontario Hydro 3% Bonds, Market value	$ 1,300.00
5 Shares Bell Telephone Stock, Market value	230.00
Bank Balance 30 Nov. 1966	197.81
	$ 1,727.81

Liabilities

Nil

Receipts

Balance in Bank 30 Nov. 1965	$ 136.89
Bank Interest	4.17
Ontario Hydro Bond Interest	45.00
Bell Telephone Dividend	11.75
	$ 197.81

Expenditures

Balance in Bank 30 Nov. 1966	$ 197.81
	$ 197.81

Audited and found correct (Signed)
J. M. Gillett and R. J. Moore, Auditors

(Signed) Margaret Wainwright, Treasurer

REVIEWS

History of the Birds of Kingston, Ontario
By HELEN R. QUILLIAM. Published by the author. 1965. Varitype and multilith. 216 pp., 29 photographs, 2 maps. $2.50. (Available from the author, Mrs. C. D. Quilliam, R.R. 1, Kingston, Ontario).

Bird observers in the Kingston region are fortunate indeed in having at a modest price such a thorough account of the bird life of that interesting part of Ontario.

Two hundred and ninety species, as well as one hybrid, are dealt with in the species accounts which make up the main body of the book. Of these, nine are considered to be hypothetical, four have been introduced (one unsuccessfully), and five cannot be expected to occur there again because of recent drastic reduction in their numbers and range extent. The Passenger Pigeon is, of course, gone forever, and species such as the Golden Eagle, Bobwhite, Whooping Crane, and Eskimo Curlew are considered unlikely to occur in that area again.

On a happier note, some species have increased considerably since the turn of the century: Green Heron, Black-crowned Night Heron, Pintail, gulls, Common Tern, Caspian Tern, Mourning Dove, Pileated Woodpecker, and Horned Lark. Evening Grosbeak invasions have much increased in winter. Ten additional species have become firmly established since the beginning of this century, mostly within the latest ten years.

Locality, numerical, seasonal, and nesting data are definite, adequately detailed, and unusually well documented. The author has been alert for evidence of changes in the local status of species found there and, in order to document changes (or lack of them), she often cites the records of H. W. Hadfield made in the region over a century ago, as well as those of Edwin Beaupré in the early part of the present century. For each species there is a list of specimens, with essential data, that have been taken in the region. Each species account closes with a brief summary statement of the status of that species.

Introductory material includes a description of the Kingston region, an account of data sources, pertinent biographical information, and precise definitions of terms used in the text. At the end of the book there is an index, a list of over 165 literature citations, and two maps of the region. There are 29 photographs and the cover is attractively decorated with a Snowy Owl, a bird that seems to have a particular fondness for the Kingston region in winter. The author is to be congratulated on the production of this outstanding piece of work.

W. EARL GODFREY
National Museum of Canada
Ottawa, Ontario

Countryman: A Summary of Belief
By HAL BORLAND. J. P. Lippincott Company, Philadelphia and New York 1965. 160 pp. $4.75.

Hal Borland has written much under other titles about natural history. In *Countryman* he writes about his involvement in nature and how it colours his thoughts, actions, ethics and attitudes. Like Thoreau's works, but without the discursive quotes from oriental philosophers, *Countryman* is a book of philosophy deeply rooted in the American soil. It follows a seasonal chronology but the logic it expresses knows no time or season.

His feeling for simplicity against modern complexity is stated in four sentences. "Too often we have mistaken facts for answers and data for truth. Fragmented ourselves by the socio-economic-industrial machine we have created, we accept fragmented answers from the machines, forgetting that even the most elaborate computer can only analyse, reduce a

problem to its components, and fails utterly to reveal that mysterious combination and unique synthesis that gives man as well as the universe both form and meaning." . . . . . "If I am to understand even those facts, let alone speculate on their total meaning, I must be in touch with both the earth and the elements. House myself away from wind and weather, isolate myself from the source of life, which is the earth itself and I have severed the roots of reality."

I owe Hal Borland my gratitude for writing such a book. You owe it to yourself to renew your faith in your outdoor environment by reading it.

V. E. F. SOLMAN

Canadian Wildlife Service
400 Laurier Avenue West
Ottawa, Ontario

Muskoxen in Canada, A Biological and Taxonomic Review

By J. S. TENER. Canadian Wildlife Service Monograph 2. Queen's Printer, Ottawa. 1965. 7 photographs, 72 tables, 1 map, 166 pp. $3.25.

Muskoxen, with their flowing masses of dark hair, fine underwool, oddly-twisted horns, short tails and whitish "socks" and "saddles," are perhaps the most remarkable of tundra mammals. They are the only high Arctic bovids; bearing no close resemblance to the more southerly bison, mountain sheep or mountain "goats". In fact, their ancestry is still poorly known. As large herbivores, they are the sole fellows of the caribou in northern reaches of Arctic America and Greenland.

Previous important references on the living muskoxen (*Ovibos moschatus*) such as those of J. A. Allen (physical development and taxonomy), Elizabeth Hone (literature review to 1934), and Alwin Pedersen (life history) lack either the balance or scholarly documentation (177 references) apparent in Dr. Tener's concise book on the species. And, of course, they are by no means current!

The author develops his theme naturally. He first concentrates on present muskox distribution, the nature of their environment and its production of muskox forage. He then tells how the animals have adapted physically, physiologically, and behaviourally to their harsh surroundings. Later he considers factors regulating population size, the history of the species, and its economic importance. About 10,000 muskoxen exist in Canada. It is encouraging to note that limited Eskimo hunting of muskoxen on certain of the Queen Elizabeth Islands is advised.

Ovibos classification is confined to the last chapter of the book, where the results of Appendix I (containing 35 tables of statistically treated measurements) are discussed with economy and caution. Findings are based mainly on a comparison of skull measurements from samples covering most parts of the species' range. An unfortunate scarcity of suitable barren ground muskox ("*O. m. moschatus*") and Hudson Bay muskox ("*O. m. niphoecus*") specimens hampered this aspect of the study. Tener concludes that living muskoxen belong to a monotypic species, *Ovibos moschatus*, which shows considerable geographic variability in skull shape, horn colour and coat colour. The generally whiter appearance, longer tooth row and higher frequency of interior columns ("styles") on upper molars of high Arctic muskoxen ("*O. m. wardi*") suggest that they are in the process of becoming a subspecies. These results are quite different from those of J. A. Allen, who in 1913 recognized three subspecies of *Ovibos moschatus* (*moschatus*, *niphoecus*, *and wardi*).

Contributions of the study are manifold. Substantial evidence is marshalled to show the important effect of nutrition on muskox size. The taxonomic status of *Ovibos* is clarified, with decisions resting on a broader, more objective quantitative base than previously. One of the greatest strengths of the work results from the author's insistence on relating: (a) muskoxen to their environment, (b) the range and biological characteristics of muskoxen to those of other mammals.

Too often monographs devoted to single species tend to leave them in splendid (and unwarranted) isolation.

The book is well produced and edited. The use of sub-chapter headings is most effective: by this means the table of contents not only outlines the scope of the monograph, but also acts as an index. Yet, clustering of photographs at the beginning of the book, rather than placing them in context seems ill advised. Some diagrams (including a map of present muskox distribution), and more photographs, graphically supplementing observations in the text would have added to the impact of the work.

Interesting research remains to be carried out on muskoxen. The author emphasizes the need for further studies on the physiological adaptation of muskoxen to their rigorous arctic environment. It would also be worthwhile to mark muskoxen in order to observe social characteristics of herds, their movement patterns and detailed behaviour. More adequate data on muskox maturation and longevity could also be gathered thus. Undoubtedly, Dr. Tener's book will be the standard work on muskoxen for many years to come, and will act as a point of departure for future research on the species.

C. R. Harington

National Museum of Canada
Ottawa, Ontario

Catalogue of Canadian Fossil Fishes

By Brian George Gardiner. Royal Ontario Museum, University of Toronto. Life Sciences Contribution 68. 154 pp., 1966. $3.50.

Fish are not common among our well-known fossil vertebrates and the remarkable Cretaceous dinosaur faunas of the western provinces overshadow almost all other Canadian fossils. Nevertheless the lowest and earliest vertebrates, as mysterious as any known fossils, figure to no mean extent in the record of life in the northern half of this continent. The publication of the ROM Catalogue of Canadian fossil fish serves to remind us that over a hundred and sixty species are known from Canadian localities; all are of interest, many are unique. The earliest include problematic bone fragments (*Astraspis*) from the Ordovician system, and the heyday of Palaeozoic fish – the Devonian period – is represented by a very wide range of fish types. Several among the latter are of world renown and have attracted the attention of all students of the fish. Mesozoic and even Quaternary forms are also conspicuous. Each year new discoveries are made especially in the west and north and palaeoichthyologists are drawn here from the U.S.A. and Europe. One such worker was the author of this new catalogue.

Dr. Gardiner, known for his studies of European fossil fishes, especially of the Mesozoic, was invited to spend a year teaching at the University of Alberta at Edmonton in 1963. His interest in fossils in Alberta led him to compile a catalogue of fossil fishes of that province and, eventually, of the whole of Canada. The product is a remarkably complete bibliography and catalogue; few references have escaped him and the whole is marked by care and clarity. There is a seven-page systematic index, eighty-eight pages of catalogue of Canadian specimens with full synonymy, location of type material and geological occurrence, forty-one pages of references and an alphabetical index of genera and species.

The catalogue is a most useful piece of work and a valuable addition to the literature on Canadian vertebrate palaeontology. It will serve for many years to come as a guide to much of the material and literature that records the evolution of the fishes. Although not a great many neontologists may use it, they will be no less appreciative of this small volume than will be palaeontologists.

D. L. Dineley

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Ottawa, Ontario

Noteworthy Bird Records from the Porcupine River Drainage, Yukon

THE purpose of this paper is to record some observations upon birds, supplementary to Irving (1960). In one season it is not always possible to record all birds present in an area. These observations contribute information to the distribution and breeding of certain birds in northern Yukon.

The observations were made during summer, 1964, while on a mammal collecting expedition supported by the National Museum of Canada. The observations listed are my own.

The expedition did not arrive in Old Crow until July 2 so that migration and breeding were over prior to our arrival.

Aythya valisineria

On July 29 a female Canvasback with six half-grown young was observed on a slough near the Bell River (Lat. 67° 32′, Long, 136° 45′). On July 30 a female with seven half-grown young was observed on the other end of the slough. I do not know if it was a different female but it nevertheless establishes a breeding record.

Pedioecetes phasianellus

On July 16 a flock of 16 Sharp-tailed Grouse were observed on the tundra 4 miles north of Old Crow at an elevation of 2500 feet. They appeared to be feeding but flew when approached. I was unable to determine if part of the group were chicks.

Canachites canadensis

The Spruce Grouse was not seen by Irving (1960) but reported as occasional by the Indians.

On July 17 a hen was seen in a spruce bog 3 miles north of Old Crow at an elevation of 2000 feet. She displayed with her tail fanned, wingtips on the ground, and neck feathers ruffled. I was unable to locate any chicks. She had completely dark tail feathers characteristic of the *franklini* race.

On August 15 a hen Spruce Grouse was seen in dense willows above the Porcupine River (Lat. 67° 27′, Long 137° 90′) at an elevation of 1500 feet. She had the dark brown band across the tip of her tail characteristic of *C.c. canadensis.*

Eremophila alpestris

On August 15 Horned Larks were seen in the tundra above the Porcupine River (Lat. 67° 27′, Long 136° 45′) at an elevation of 2000 feet. There was one small flock of an undetermined number that alighted near me for a few minutes and flew on.

Myadestes townsendi

Only one Townsend Solitaire was seen all summer. It was at tree line (elevation 2000 feet) in the mountains above the Bell River (Lat. 67° 32′, Long. 136° 45′) on July 28. It sat motionless in a snag and did not sing.

Spizella arborea

Tree Sparrows are abundant and listed by Irving (1960). He reported what he considered to be an unusually late nest with half-incubated eggs on June 29. On July 20, 3 miles north of Old Crow, at an elevation of 2000 feet, I located a nest with 3 young that had not yet begun to fledge. This must have been an even later nesting or renesting.

Zonotrichia atricapilla

Three Golden-crowned Sparrows were seen on July 27 in the mountains above the Bell River (Lat. 67° 32′, Long. 136° 45′) at an elevation of 2000 feet. They were in a region dominated by dwarf birches but did not seem to be feeding.

REFERENCE

IRVING LAURENCE. 1960. Birds of Anaktuvuk Pass, Kobuk, and Old Crow. United States National Museum Bulletin 217:1-409.

IAN STIRLING

Department of Zoology
University of Canterbury
Christchurch 1, New Zealand
11 March 1966

The CANADIAN IELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

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THE CANADIAN FIELD-NATURALIST

FOUNDED IN 1879

The objectives of the club are to foster an acquaintance with and a love of nature, t encourage investigation and to publish the results of original research and observation in all branches of natural history.

The club is a corporate member of the Federation of Ontario Naturalists and i affiliated with the American Association for the Advancement of Science.

MEMBERS OF COUNCIL

THE OTTAWA FIELD-NATURALISTS' CLUB

The Canadian Field-Naturalist is published quarterly with the assistance of affiliate societies and of a contribution from the Canadian National Sportsmen's Show. Manuscripts representing observations or the results of original research in any branch o natural history are invited. Contributions to the Letters and to the News and Commen sections are welcome. All material intended for publication should be addressed to th editor. Opinions and views expressed in this journal are private and do not necessaril reflect those of The Ottawa Field-Naturalists' Club or of any other agency.

Authorized as second-class mail by the Post Office Department, Ottawa, and for the payment of postage in cash.

The Canadian Field-Naturalist

'olume 81 APRIL-JUNE 1967 Number 2

EDITORIAL

The New Natural History

That a radically new kind of natural history is gradually emerging in ıany parts of Canada and the world is now apparent to people in many walks f life. This "New Natural History" is being created by the vast transforma- ions that man is continuing to make in the environment of which he forms part. Perhaps the most unfortunate consequence of man's thoughtlessness nd greed toward the world around him is that both the health and the beauty f many of the earth's natural environments are becoming degraded to the xtent that many forms of life are disappearing or are being threatened with xtinction. Two of the most serious kinds of environmental degradation, as hey affect wildlife and other types of natural history, are pollution and the lestruction of habitat. Much of our native fauna cannot survive in polluted ivers and lakes and on landscapes that are heavily impregnated with DDT nd other persistent biocides. For many forms of life (particularly for those iving at the ends of food chains), biocides such as DDT are now recognized o be at least as dangerous to life as atomic radiation.[1] Even man himself is ıeginning to feel the effects of the environmental degradation which he is :ausing. In many areas, particularly near our cities, the land, air and water re becoming unsightly and offensive to more than one of our senses. As our :ivilization expands many other areas will experience the same kind of leterioration.

It is clear that we must make more serious efforts to protect samples ɔf natural and semi-natural landscapes as well as suitable habitats for wildlife. Otherwise, as development expands and technology becomes more powerful, we shall lose all or nearly all such places from vast regions of the continent. Not only do such natural areas provide the only possible homes for species of wildlife but they provide scientists with whole living laboratories having special :elevance to the surrounding countryside. Natural systems and communities nust be adequately understood if man is eventually to arrive at some balanced :elationship with the world. From the point of view of agriculture and land ıealth, natural communities, since they have survived for millions of years, provide the very best models of balanced systems. But such communities are ɔnly beginning to be studied and their loss jeopardizes an adequate understand- ing of the land.

[1]See article by Woodwell, G. M. 1967. Toxic substances and ecological cycles. Scientific Ameri- :an 216:24-31 (available at many public libraries).

Mailing date of this number: June 9, 1967

Another aspect of the changing natural history of our times results from the elimination or alteration of even outstandingly beautiful parts of our native landscape. Such destruction is often needless, local, and known only to the residents of the area concerned. For example, few persons outside of Toronto know that the Ernest Thompson Seton Park is now being used as a garbage dump; in most cities and towns one can find examples of needless encroachment onto parks, open spaces and other beautiful areas. In far too many of these cases, long-range objectives are sacrificed for short-range expediency and, as a result, the world becomes a poorer place in which to live. Places of natural beauty can be retained within our cities and in our countryside but only if people speak up on their behalf. In no case should the safety or the beauty of an area be taken for granted.

It is with some of these thoughts in mind that two new sections are being added to THE CANADIAN FIELD-NATURALIST. One of these sections will include an editorial and letters to the editor; the other is entitled News and Comment. Contributions to these sections will be welcomed. The letters to the editor will provide a forum through which readers will be able to comment on current events and developments affecting the field of natural history and environment, or in which readers will be able to respond to items appearing in the journal. The News and Comment section will deal with activities, policies and legislation relating to land use, national and provincial parks, pollution, natural science education, conservation, biological research, species preservation activities and so on. Letters and other contributions to these sections will be accepted on the basis of brevity, clarity, pertinence and importance.

As naturalists, and as professional biologists, most of us have not been concerned with the preservation of nature; we have, rather, been concerned with studies of nature for their own sake. We have, therefore, looked after our broader interest only indirectly. The time is here for many more of us to do so directly. The New Natural History recognizes that man is becoming an increasingly dominant force in nature; that he is modifying the environment to an unprecedented degree and that many of these modifications are not in man's interest. The New Natural History requires that more of us as naturalists, scientists, and as citizens of the country in which we live, recognize that we have a responsibility to speak out and to act on a wide range of matters which are determining today what kinds of enjoyment, wildlife and research will be possible tomorrow.

THEODORE MOSQUIN

HABITAT RESTRICTION BY COMPETITIVE EXCLUSION IN THE MICE *PEROMYSCUS* AND *MUS*

Walter Sheppe

California Academy of Sciences, San Francisco*

To be suitable for any species of animal a habitat must be capable of supporting the animal and must have the necessary perceptual characteristics — that is, the species must select it as a place to live. In addition, some habitats otherwise suitable are not available because of the presence of competing species. The effect of these factors on the distribution of the deer mouse, *Peromyscus*, has been discussed elsewhere (Sheppe, 1961, 1965a).

Each of these factors affected the distribution of the mice on a ranch in British Columbia. This paper includes a brief description of the habitats occupied by each species, presents demographic data for two species, and describes two experiments designed to test the importance of competitive exclusion.

The study was conducted on the Wright ranch, four miles southwest of Princeton, B.C., and 30 miles north of the United States border. The ranch is near the eastern foot of the Cascade Mountains at about 3,000 feet elevation. It is on the western edge of the interior dry belt, characterized, in order of increasing dryness of sites, by Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), and open grassland (Brayshaw, 1965). Lodgepole pine (*Pinus contorta*) grows on a variety of sites. Most of the forests near the study area are dominated by Douglas fir.

Methods

Mice were observed by trapping and by smoked paper tracking, from June 19 to August 24, 1965. Most data are from livetrapping with Sherman traps baited with crimped oats. Animals trapped in this way were marked with an ear tag and released. Observations made on all mice included breeding condition, pelage (of *Peromyscus*), molt, body length, and wounds. The internal reproductive organs of dead mice were examined and the skulls were saved to be examined for tooth wear.

Peromyscus in this region has a long hiatus in breeding during the winter, and mice could be classified as adult (born prior to 1965) or young (born in 1965) on the basis of pelage, tooth wear, and body length. Age classes were not as distinct in *Mus*, suggesting that the population may have produced young all winter. Most of the *Mus* could be classified as adult or young on the basis of tooth wear and body length, but the absolute age of the mice could not be determined.

*Present address: University of Zambia, P.O. Box 2379, Lusaka, Zambia.

Livetraps were set in three ways:

1. A single trap was set at each of 74 stations in and around the ranch buildings (Line 1). There were large Sherman traps at 25 stations and small ones at 49. Later when more traps were available two small traps sometimes were set at each station. Line 1 was set on an irregular schedule, for five days in June, five in July and early August, and two at the end of the study. It was checked three to six times per day, sometimes including a run during the night.

2. At times a large number of traps were set for one night in a small part of the study area, such as in and around one building, when there were no traps in other parts of the area. This provided additional information on movements by increasing the probability that a mouse entering the area would be caught and by not interfering with the mouse's movements by trapping it elsewhere.

3. Traps were set in most of the surrounding areas at some time. This provided information on the species present and their habitat distribution, and on the movements of mice into and out of the area of Line 1. Trapping in a wooded ravine provided information on the status of a population that had been manipulated earlier.

The method of tracking has been described elsewhere (Sheppe, 1965b). A cardboard milk carton containing a smoked card was set at each station on Line 1 on an irregular schedule and checked several times each day. Toes were clipped from all *Mus* and *P. maniculatus* trapped on the study area to permit identification of tracks. Some mice were given individual toe numbers, but there are too few toes to provide satisfactory numbers for all of the mice and most were given a number characteristic of the species. It usually was possible to identify even unmarked tracks to genus.

Experiment 1 had been conducted previously in a ravine south of the ranch buildings. Limited livetrapping was done there in 1965 to determine the distribution of each species at that time. Experiment 2 was conducted in the area of the ranch buildings. After the initial descriptive study most of the mice were removed from the feed shed to observe the effect on the movements of other mice. Additional mice were removed from time to time. Most were caught in snaptraps baited with peanut butter or raisins, the others in Sherman traps.

RESULTS

Experiment 1

This experiment was conducted in 1957, and the results through 1959 have already been reported (Sheppe, 1961). In 1965, 600 trapnights were run to learn the distribution of each species.

Plants characteristic of the subalpine forest to the west are found in a few sheltered sites on the ranch, of which the most important is a north-facing indentation, called the "ravine," in the hillside 30 yards south of the ranch buildings. An area of about three acres on the floor of the ravine has scattered large Engelmann spruce (*Picea engelmanni*), Douglas fir, and aspen (*Populus tremuloides*). In places there are thickets of red osier (*Cornus stolonifera*) and other shrubs 10-20 feet high.

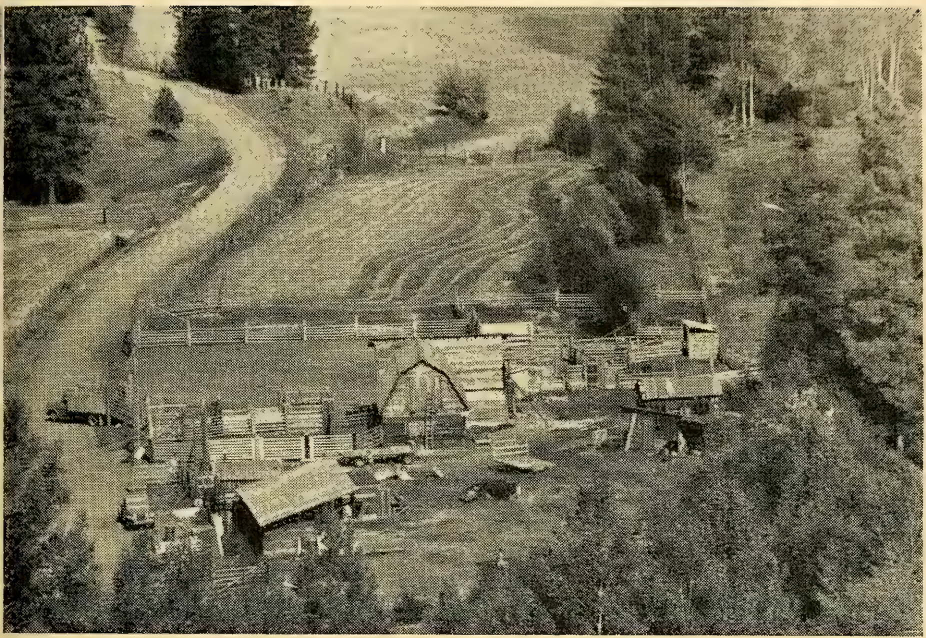

FIGURE 1. View of the barns and corrals, looking east. The gabled building near the center of the photograph is the horse barn.

Several species of small mammals characteristic of higher altitudes were found in the ravine. The shrew mole, *Neurotrichus gibbsi gibbsi* (Baird), is a coastal species, and the Wright ranch is the only locality where it is known to occur east of the Cascade summit in British Columbia. One was trapped in the ravine in 1965 and another by the creek ¼ mile farther west. The red-backed mouse, *Clethrionomys gapperi saturatus* (Rhoads) occurs throughout the region at higher elevations, but the ravine is the only place where it has been found in the immediate vicinity. The long-tailed vole, *Microtus longicaudus mordax* (Merriam) also was common there.

The ravine seems to be the easternmost locality of another mountain species, *Peromyscus oreas* Bangs. Earlier work had revealed a dense population of *P. oreas* on the floor of the ravine, overlapping slightly with the sparse population of *P. maniculatus artemisiae* (Rhoads) on the surrounding hillsides. A few *P. oreas* also were found along the creek a short distance from the ravine. The absence of *P. maniculatus* from the floor of the ravine suggested that it was being excluded by *P. oreas*, and in 1957 the population of *P. oreas* was removed. In the following two years small numbers of *P. maniculatus* but no *P. oreas* were found in the area formerly occupied exclusively by *P. oreas*. This seemed to confirm the hypothesis of competitive exclusion.

In 1965 the *Peromyscus* populations had returned to their original condition. The floor of the ravine was occupied by a dense population of

P. oreas and the sides by a sparse population of *P. maniculatus*, with a narrow zone of overlap. *P. oreas* was especially common in the osier thickets. The 25 *P. oreas* that were trapped in the ravine probably represented almost the entire population, as contrasted with the 58 that were removed in August 1957.

Small numbers of *P. oreas* also were found in several other relatively moist sites where it had not been taken in previous years. Only one was ever trapped around the ranch buildings, a juvenile male that was trapped outside the old house on one day but later settled in the ravine.

Experiment 2

The ranch buildings and corrals (Figure 1), with an area of about one acre, had populations of *Peromyscus maniculatus* and of the house mouse, *Mus musculus* L., that were denser than any population in natural habitats. Initial trapping suggested that competitive exclusion was affecting the distribution of these species in the buildings, and an experiment similar to Experiment 1 was conducted to test this hypothesis. Basic data on habitats and demography will be presented, followed by a description of the experiment.

Habitats: There is dry forest to the west of the buildings, and hayfields on the other sides. Barley was the principal crop in the hayfields; it matured and was harvested during the study. A small creek flowed along the southern edge of the area. The area between buildings 1-2 and 3-5 (Figure 2) was largely bare, and the corral northeast of buildings 6-9 was entirely bare. The area between buildings 3-5 and the creek had a dense growth of grasses (*Bromus inermis* and *Agropyron repens*) and weeds. Pigweed (*Chenopodium album*) and other herbs were abundant around many of the buildings, in the corrals between buildings 9 and 10, along the creek, and between the creek and the road on the eastern edge of the map.

The buildings and their characteristics as mouse habitat were: (1) House — abundant food and shelter; (2) Sawdust shed — no food, abundant shelter; (3) Tractor shed — no food, little shelter; (4) Fuel shed — no food, little shelter; (5) Generator shed — no food, little shelter; (6) Horse barn — some food and shelter on the ground floor; the loft contained hay that provided some food and good shelter; (7) Hay barn — empty in June, but *Mus* had dug holes in the dirt floor; later it was filled, providing food and shelter; (8) Abandoned privy — no food, little shelter; (9) Feed shed — abundant food and shelter; (10) Cow shed — little food and shelter; (11) Saddle shed — some food, much shelter; (12) Tool shed — no food, some shelter; (13) Carriage shed — little shelter but with a sack of feed; (14) Old house — no food, abundant shelter; mice living here fed in the barley field in back; (15) Cabin — some food, abundant shelter; (16) Woodshed — no food, abundant shelter.

Species present: *Peromyscus maniculatus* is the most abundant mammal in the area. It was found in almost all natural habitats on the ranch and in and around all of the buildings. Mice living elsewhere went into the hayfields to feed on the grain. *Mus musculus* was found in high density in some of the barns and in lower density in adjacent buildings and corrals, but never in hayfields or wooded areas.

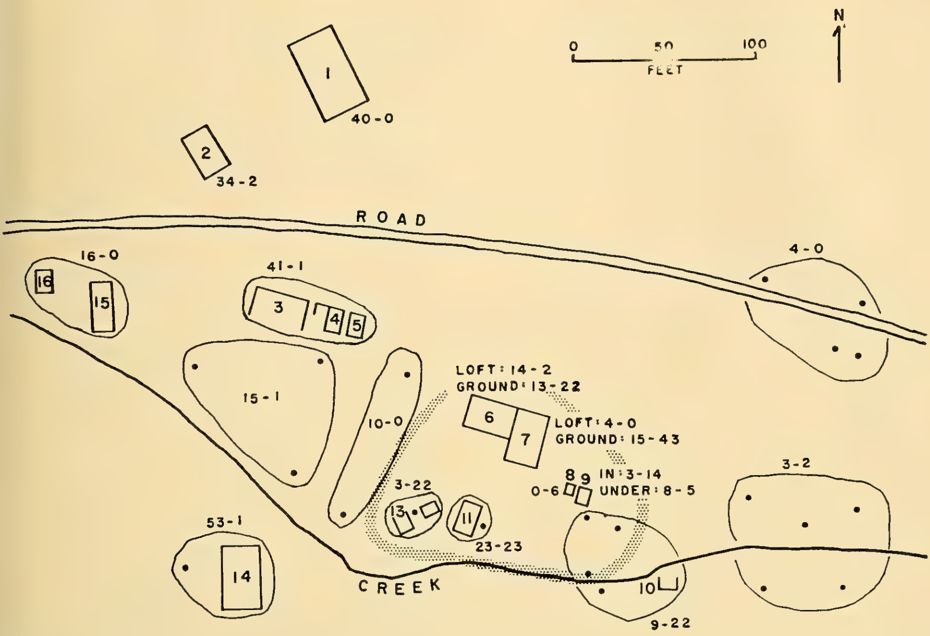

FIGURE 2. Map of the ranch buildings. Hyphenated figures show the number of records of *Peromyscus maniculatus* (left) and *Mus musculus* (right) from each group of traps during the period June 19 to July 10. *Mus* was rarely recorded outside the stippled line.

At least six other species of rodents lived in or around the ranch buildings. Meadow voles, *Microtus pennsylvanicus drummondi* (Audubon and Bachman), were abundant in low vegetation around the buildings and occasionally entered buildings. *Microtus longicaudus* was found in wooded areas nearby and occasionally in or around buildings. A single jumping mouse, *Zapus princeps kootenayensis* Anderson, was trapped by the creek. Wood rats, *Neotoma cinerea occidentalis* Baird, were seen occasionally in several buildings. Chipmunks, *Eutamias amoenus felix* (Rhoads) were common throughout the area and often were trapped near buildings. One of them occasionally entered the feed shed. The burrows of pocket gophers, *Thomomys talpoides incensus* Goldman, were abundant in parts of the ranch yard with tall grass and in the surrounding hayfields.

Adequacy of the data: The data probably give an adequate picture of the distribution of most of the species of mice and a useful idea of their relative abundance, and there are enough records of many *P. maniculatus* and some *Mus* to show their home ranges. The trapping schedule and the distribution of traps were too irregular to permit extensive statistical analysis of the data. Each species was exposed to a different intensity of trapping and tracking and each responded differently, so that quantitative comparisons of species are

difficult. *Peromyscus* is nocturnal while *Mus* is active day and night and thus could have been recorded on more runs. On the other hand, the *Peromyscus* had larger home ranges and thus were exposed to more traps.

P. maniculatus entered traps readily and adults were trapped at least once on 79 per cent of the days they were believed to be present. Some *Mus* also were trapped readily, but adults were trapped on only 32 per cent of the days they were believed present. These figures are not entirely comparable because of differences in trap exposure. In spite of heavy livetrapping in the feed shed many untagged *Mus* were caught there when snaptraps were set, but few untagged *Peromyscus* were ever caught by snaptraps. Some *Mus* were live-trapped once and not caught again until snaptrapped. A few left track records long after they were last trapped. However, a few were trapped repeatedly. Such heterogeneity of records is familiar in *Mus* (Young *et al.*, 1952; Crowcroft and Jeffers, 1961). In the present study it apparently resulted largely from differences in trap response rather than in trap exposure. Adult *P. maniculatus* were trapped two to 31 times ($\bar{x} = 9.8$), adult *Mus* one to 17 times ($\bar{x} = 3.8$). In both species the maximum and mean number of records were much greater for males than for females.

Both *Peromyscus* and *Mus* show slight neophobia and strong neophilia (Crowcroft and Jeffers, 1961; Sheppe, 1966a). The data of this study are not suitable for demonstrating such behavior, but they presumably were influenced by it. More likely to affect the validity of the data is the disturbance in mouse behavior caused by trapping. *Peromyscus leucopus* (Rafinesque) leaves many more track records after being trapped than at other times, and sometimes travels far outside its previous home range (Sheppe, in press). A small experiment on Line 1 showed that *P. maniculatus* also leaves more records after being trapped, partly because when released it is active for some time during the day, when ordinarily it would not leave the nest (Sheppe, in press). The population of *Mus* was too low at this time to show whether it responds similarly to trapping. There are too few track data to show whether mice ever left their home ranges after being released from traps, but some of the observed shifts of home range may have been caused by the disturbance of trapping.

Population structure and reproduction: A total of 124 *P. maniculatus* were recorded on Line 1, including 61 males and 63 females (Table 1). In the first 10 days 24 adults and 27 young were recorded, and these 51 mice probably represented the entire population of trappable size. In the next two months only 10 new adults (1 ♂, 9 ♀ ♀) were recorded, but young mice (34 ♂ ♂, 29 ♀ ♀) continued to be recorded at a reduced but nearly constant rate. All of the new adults and most of the new young probably were immigrants. Two of the adults and seven of the young had originally been trapped in surrounding areas. Population estimates for subsequent 10-day periods ranged from 31 to 49, but these estimates are less reliable than that for the first period because there are fewer data. These population estimates cannot be converted directly into density figures because the home ranges of many of the mice extended a

TABLE 1. — Source and fate of *Peromyscus maniculatus* and *Mus* on line 1. Eight *Mus* of unknown age are omitted. Figures in parentheses are percentages

	P. maniculatus		*Mus*	
	ADULT	YOUNG	ADULT	YOUNG
TOTAL	34	90	41	34
SOURCE:				
First trapped on Line 1,				
on June 19–28	24 (71)	27 (30)	31 (76)	18 (53)
on June 29 – August 24	8 (24)	56 (62)	9 (22)	16 (47)
Immigrants	2 (6)	7 (8)	1 (2)	0
FATE:				
Dead	12 (35)	38 (42)	25 (61)	20 (59)
Emigrants	4 (12)	7 (8)	0	1 (3)
Trapped on August 23–24	5 (15)	16 (18)	0	0
Unknown	13 (38)	29 (32)	16 (39)	13 (38)

short distance outside the area of Line 1, but densities here clearly were much higher than in other habitats.

Eighty-three *Mus* were recorded on Line 1 (43 ♂♂, 40 ♀♀). These figures include a few mice of unknown age. As in *P. maniculatus* a higher per cent of adults than of young were trapped in the first period, but the difference was not as great in *Mus*. There were no *Mus* in adjacent areas and no feed or hay were brought onto the ranch during the study, so that the adult *Mus* trapped after June 28 must have been present earlier but not captured. Some of the young *Mus* trapped after June 28 must also have been present earlier, but others probably were not then old enough to be trapped.

All adult female *Peromyscus* bore one or two litters in the spring, prior to the beginning of the study. One female that died on June 27 had nursed a litter and was pregnant again, but there was no evidence that any litters were born during the study. In June a third of the adult females had perforate vaginas, but after mid-July only one was perforate. No young mice bred, but a few females that had begun the subadult molt were perforate in June. The breeding condition of males cannot be determined reliably from external examination. Two adults examined post-mortem in June and July had large testes and epididymides, but those of six mice examined in August had retrogressed. None of 27 young males were sexually mature. If there is a late breeding season it had not begun by August 24. Previous work (Sheppe, 1963) showed that in some years breeding continues much later into the summer, but produced no evidence of fall breeding.

Breeding continued later in *Mus*, but the population was almost extinct by the middle of July and few data are available after that. In June two-thirds of all females were perforate; thereafter about half were. Three pregnant

adults that had already borne a litter were trapped on July 10-11, three recently born litters were found on July 11, and one litter first left the nest on July 30. Almost as many young females as adults were perforate (50 vs 60 per cent) even in June, but no pregnant young were seen. Most males, both young and adult, had descended testes throughout the study.

Table 1 shows that most of the adult and young *P. maniculatus* seem to have met similar fates. Most of the dead mice died in traps, but a few were found dead of unknown causes. Seven were killed in the house. Both age groups of *Mus* also met similar fates, though a much higher per cent of *Mus* are known to have died. The most important cause of natural mortality in both species may have been weasels. *Mustela erminea* L. was sometimes seen or trapped in the buildings and *M. frenata* Lichtenstein also was present.

A number of *P. maniculatus* were recorded both on Line 1 and elsewhere. If their first or last record was elsewhere they are classed as immigrants or emigrants, but this may not be justified because the home ranges of some mice extended from Line 1 into surrounding areas and sometimes these mice were trapped alternately inside and outside the area of Line 1. Most mice living in the buildings were not recorded elsewhere, but the immigrants, emigrants, and mice with overlapping home ranges must have assured a high degree of continuity with the surrounding population.

Only three *Mus* were trapped anywhere but on Line 1. These were in localities about 100 feet away.

Patterns of movement: There are five or more records of 55 *P. maniculatus* ($\bar{x} = 16.2$ records) and 16 *Mus* ($\bar{x} = 13.9$ records). These data give a general picture of the areas used by most of these mice, but the long time during which the records were made and the irregular distribution of traps makes it impractical to calculate home range sizes. Several *P. maniculatus* with apparently stable home ranges were recorded over distances of 200 feet or more, most were recorded over much smaller distances, and some were recorded from only one building. The home ranges of *Mus* were much smaller, usually being confined to one or two buildings.

Movement patterns and home range tenure were highly varied. These were arbitrarily classified as stable home range, partial or complete shift of home range, and wandering without established home range. In *P. maniculatus* all but one of the 10 wandering mice were young; otherwise there was no clear relation between these categories and age or sex. There was an apparent relation with length of time the mouse was observed and with number of records. The 23 mice that shifted their home ranges were observed for much longer than the 22 mice with stable home ranges ($\bar{x} = 45.3$ days vs. 29.0 days) and had many more records ($\bar{x} = 23.4$ vs. 12.7). Wandering mice were observed over 28.9 days but left only 7.3 records. The ranges of some mice extended outside the area of Line 1, but too little trapping was done in the surrounding area to show this clearly.

The home ranges of *Mus* seemed to be more stable than those of *P. maniculatus*, but this may have been an artefact – most *Mus* left fewer records and were present for a shorter time. Because the home ranges of *Mus* were

smaller they contained fewer traps than those of *P. maniculatus* and hence cannot be depicted in as much detail. The 10 adults and four young with stable home ranges were observed for an average of 21.8 days and left 12.8 records; the two adults that shifted their home ranges were observed for 53.5 days and left 21.5 records. Several mice with fewer than five records seemed to be wanderers.

Instability of home ranges undoubtedly was greatly increased by human activity – the after-trapping effect, habitat changes, and the death of other mice in traps. The most important habitat change was the filling of the hay barn on July 1. Before this the ground floor had been heavily used by *Mus*, but after this *Mus* was rarely recorded there and *P. maniculatus* was recorded much more often than before.

Intraspecific social relations: Something of the social structure of the populations can be learned from the locations where each mouse was recorded and from the occurrence of multiple captures and of wounds. In a previous study of *P. leucopus* (Sheppe, 1966b) it was found that members of the same sex and age group tended to have separate home ranges, though there was extensive overlap of the ranges of mice in different groups. In the present study no such tendency was observed. Often several mice of the same sex and age lived in a building at the same time. During the period June 20-30, when human disturbance was at a minimum, four adult male and one female *P. maniculatus* were recorded from the saddle shed, five adult males and four females from the old house, and four adult females and two males from the sawdust shed. Most of these mice used the entire building, and there was extensive overlap of home ranges.

Mus home ranges overlapped broadly. This was especially true in the feed shed, where 24 mice were removed in three days.

Sherman traps are designed to catch only one mouse at a time, but there were 14 double captures of *P. maniculatus* and 11 double and two triple captures of *Mus*. All of the mice were young except for one capture of an adult female *P. maniculatus*, one of an adult male *Mus*, and five of adult female *Mus*. The only multiple capture of adults was one of two adult female and one young *Mus*.

Of the double captures of young mice, there were eight of one male and one female *Mus* and one of two males. Only half of the captures of two young *P. maniculatus* were bisexual – six bisexual, two of two males, and four of two females. The greater proportion of bisexual pairs in *Mus* probably is correlated with the fact that whereas about half of the young *Mus* seemed to be in breeding condition only one *P. maniculatus* did. Some of the mice were caught with other mice several times, usually with different companions each time.

Multiple captures probably indicate that the mice were traveling together, though the trigger mechanism is crude and it may be that two mice entered the trap separately and their combined weight was enough to set it off. If the mice traveled together this indicates that there was a social bond between them.

Table 2. — Per cent of *Mus* and *Peromyscus maniculatus* with tail scars. Figures in parentheses are sample size

	male		*female*	
	ADULT	YOUNG	ADULT	YOUNG
Mus	95 (21)	50 (8)	88 (17)	44 (9)
P. maniculatus (Line 1)	67 (15)	15 (13)	50 (14)	16 (32)
,, (other lines)	0 (1)	7 (28)	0 (5)	0 (21)

If they arrived separately their presence in the same trap at least indicates that they did not avoid each other as do male *Rattus norvegicus* (Davis, 1955). It is probable that most of the young trapped together were siblings and that most of the adult females were the mothers of the young they were trapped with. Adult mice seem to be usually solitary.

Fighting in *Mus* often produces small scars on the body and tail, which provide an index to the amount of fighting in the population. Table 2 shows that on Line 1 most adult *Mus* and about half the young had tail scars at some time. Adults often were heavily scarred, but the young usually had no more than one or two scars.

Tail scars were less common and usually less severe in *P. maniculatus*. As in *Mus*, adults were much more affected than young and the highest incidence was in adult males. There were almost no scars on mice trapped on other lines, though the figures are not entirely comparable because most of these mice were seen only once or twice.

No mice were badly wounded and not all of the scars were caused by fighting, but the high incidence of scars in *Mus* shows that fighting must have been common in this population. Scarring was no worse in mice from the feed shed than in those from other places. Adult *P. maniculatus* living on Line 1 also must often have been in fights. The high density may have led to an unusual amount of intraspecific fighting, but the nature of the wounds suggests that they were made by *Mus*.

Interspecific relations: The distribution of these species in and around the ranch buildings overlapped widely, but there was a strong tendency toward segregation. Figure 2 shows the number of trap records of both species from each group of traps during the first 22 days. There is a slight negative correlation (—0.291) between the numbers of records of the two species, but the amount of segregation was greater than that would indicate. There were equal numbers of records from one group of traps. *P. maniculatus* predominated in 12 groups, with 242 records of it and only 14 of *Mus*. *Mus* predominated in six groups, with 129 records of it and 43 of *P. maniculatus*.

Mus were concentrated in a small group of barns and sheds, and some seemed to live entirely in the weed-grown corral south and east of the feed shed. The greatest concentration of activity was in the feed shed; this is not

FIGURE 3. The interior of the feed shed. Paper feed sacks are on the left; the sack on the right contains oats. The mixture of feed pellets, powdered pellets, and mouse droppings can be seen in the far corner.

reflected by the data in Figure 1 because *Mus* seldom entered traps there, perhaps because of the abundant food always present. Smoked cards in this shed usually were heavily tracked by *Mus*, these mice often were seen, and there was abundant sign of their activity. *P. maniculatus* was rarely recorded there.

The feed shed provided unusually favorable mouse habitat, with an abundant supply of food and cover, and was readily accessible. It was 6 by 8 feet in size, loosely constructed of planks, resting on two logs that held it 8 inches off the ground. Two steel drums contained feed that was not accessible to the mice, but most of the floor was covered by several dozen large paper sacks of beef feed pellets and a sack of crimped oats (Figure 3). The beef pellets had been put in the shed two months before the study began and the population of *Mus* had formed since then. During this time the mice had eaten large holes in the sacks and crumbled most of the pellets, covering the floor of the shed with powdered feed to an average depth of 8 inches. Numbers of *Mus* were living and breeding in partly empty sacks. The powdered feed contained many fecal pellets, and in places was cemented into large blocks by urine.

Mice often were seen to go in or out of the building through a hole. Six of the 24 mice later trapped there in the initial removal had been recorded elsewhere, five to 40 feet away, but there are too few records to show the amount

of contact between mice living in the shed and those living elsewhere. It is not known whether mice nesting elsewhere entered the shed to feed.

There were few records of *P. maniculatus* from the feed shed in spite of the concentration of food and shelter and the intense trapping and tracking effort there. One left tracks on the night of July 2 and three were trapped on the next two nights, but for the next six nights there were no records. Traps and track shelters set on the ground beneath the shed were visited more often – there were 12 records of six mice during the period June 20 to July 10. Apparently mice sometimes came to the shed to use the food that littered the ground beneath it, but rarely entered the shed itself.

The failure of *P. maniculatus* to use the richest source of food on the ranch suggested that the large *Mus* population was keeping these mice from entering the shed. To test this idea most of the *Mus* were removed from the shed. If *P. maniculatus* then began to visit the shed regularly this would confirm the hypothesis of competitive exclusion. If not, it would suggest that the shed was not attractive to this species and that the presence of *Mus* had been irrelevant.

The initial removal of mice was by 21 snaptraps set at 1100 hours on July 10 and checked frequently until they were removed at 2000 hours on July 12. Twelve *Mus* were trapped in the first 12 hours, eight in the next 24 hours, and four in the final 21 hours. Through a misunderstanding the feed sacks were removed on July 11. In one of them 17 infant *Mus* were found, apparently from three litters. These mice and much of the food were removed from the shed, but the empty and partly empty sacks were returned so that there was still abundant cover and a large supply of food.

After the initial removal period tracking showed that *Mus* continued to use the shed, though the cards were much less heavily tracked than before removal. Snaptraps and livetraps set in the shed during the daylight hours of July 17-28 caught nine *Mus*, but the cards continued to be tracked by mice that did not enter the traps.

One *P. maniculatus* was trapped on the first night the snaptraps were set and on the second night two were trapped and two tracked for a total of five mice recorded in two nights (Table 3). During the next month cards were present on most nights, but only a few mice could be identified individually from their tracks. Traps were set on only six nights, to avoid interfering with the movements of the mice.

Fourteen *P. maniculatus* were recorded in the shed during this period, but most of them apparently did not use it regularly. There were 51 repeat records of a possible 139 (37 per cent). The number of records would have been greater except that the mice were trapped elsewhere 62 times and left almost no records in the shed on those nights. An adult female was recorded in the shed on nine of the first 12 nights and beneath it on the other three. She was accidentally killed on the twelfth night. An adult male was recorded inside on 16 nights. The other mice were recorded on one to seven nights each.

The rate of invasion was irregular. When livetraps were set in the shed on the fifth night after removal of *Mus* only two *P. maniculatus* were caught,

Table 4. — Sex and age of mice recorded in the feed shed, and of *Peromyscus maniculatus* present on Line 1 after the removal of *Mus* but not recorded in the feed shed

	SEX		AGE			Total
	Male	Female	Adult	Young	% Adult	
Mus removed from feed shed						
July 10-12	14	10	14	8	64	24*
July 17 – August 16	5	8	4	6	40	13*
P. maniculatus recorded in feed shed	11	11	8	14	36	22
P. maniculatus not recorded in feed shed	30	28	12	46	21	58

*Age of a few mice unknown.

both of which had been recorded there before. When livetraps were set again 12 nights later eight *P. maniculatus* were caught, six of them recorded there for the first time. In the interval nine additional *Mus* and one *P. maniculatus* had been removed.

The *P. maniculatus* recorded in the feed shed came from all parts of Line 1 except the two buildings north of the road. The nearest record of these mice prior to July 10 was: 5 mice in or under the feed shed, 11 mice 40 to 350 feet away, and six mice with no record. There was a tendency for mice to come from greater distances as time progressed, although the mice were not removed from the study area. Five or six mice that had been tagged prior to July 10 were first recorded at the shed in each of three periods: July 11-14 and 25-29 and August 9-16. There was great variability within each group but the mean distance of the nearest previous record increased steadily: 48, 94, and 126 feet. Two mice that had not been tagged prior to the beginning of the experiment were recorded at the shed in the second period and four in the third; these mice must have been immigrants to Line 1.

There are enough data on several mice to compare their home ranges before and after they began using the feed shed. One adult female apparently abandoned her previous range when she began using the shed every night, but there was no indication that one young female abandoned any of hers. After one adult male began using the shed he continued to be recorded in the horse barn but not in the saddle shed or tool shed. Another adult male continued to be recorded most often in the vicinity of the tractor shed, but occasionally more than doubled the extent of his movements to visit the feed shed. Similar differences in response to a new food supply have been observed in *P. leucopus* (Sheppe, 1966b).

The sex and age structure of the mouse populations in the shed is shown in Table 4. There were approximately equal numbers of males and females of both species. A majority of the *Mus* trapped during the initial removal period were adults, but a majority of those subsequently trapped were young. Adults

formed only a small part of the *Peromyscus* population on Line 1 at this time, but the proportion of adults was much higher in the shed than elsewhere. The differences for both species suggest that adults tended to pre-empt use of the shed.

A month after the initial removal the use of the shed was stable and there were almost no records of *Mus* from elsewhere. One litter of *Mus* had appeared suddenly in the shed but disappeared almost immediately. There was no indication that the populations of *Mus* in the shed would build up again in the near future or that *Mus* would be able to displace *Peromyscus* from the shed.

At this time there were numbers of *P. maniculatus* living in the surrounding areas but few new ones were being recorded from the shed. It seemed probable that other mice were kept away by social interaction with mice that already were using it. To test this hypothesis snaptraps were set in the shed on the nights of August 14-15 to remove all *Peromyscus*. Thirteen were trapped, four of them for the first time in the shed. Four *Mus* also were trapped.

Observations continued for eight nights after this. One *Peromyscus* left tracks on the second night, but there were no other records of either species. There was no invasion by new mice and the three remaining *Peromyscus* that had previously been recorded in the shed had ceased to use it. An adult male that had been using the shed regularly left tracks there on the first night that snaptraps were set, but was not recorded there again.

The area of Line 1 was saturated with livetraps on the last two nights, August 23-24. One *Mus* and 31 *P. maniculatus* were trapped in areas south of the road. These mice could have invaded the feed shed, but none did so.

Discussion

The various small mammal species on the ranch had widely overlapping distributions, but each was found in a different combination of habitats. These habitat restrictions seem to have been a result of the survival and perceptual characteristics of the habitats, and of the presence of competing species.

Peromyscus maniculatus is found in almost all habitats in this area. This habitat adaptability must facilitate invasion of the ranch buildings. These buildings are perceptually very different from any of the natural habitats in the area, but have such favorable survival characteristics that they support populations denser than those in any natural habitat. The species is excluded from two of the most favorable sites by the presence of other mice — from the ravine by *P. oreas* and (formerly) from the feed shed by *Mus*.

The distribution of *P. maniculatus* and *P. oreas* in the ravine in 1965 supports the original conclusion that *oreas* prevented *maniculatus* from using the floor of the ravine. *Maniculatus* had moved onto the floor after *oreas* was removed, but prior possession was not enough to permit *maniculatus* to maintain itself when *oreas* returned. The nature of the interaction between the two species is not known.

There was a dense population of *P. oreas* in the ravine and small numbers in other moist sites. For these scattered bits of suitable habitat to remain

TABLE 3. — Trap and track records of *Peromyscus maniculatus* from the feed shed. Each mouse is counted only once per night. All tracks of mice not distinctively marked are counted as one mouse each night, and the actual number of visits during the period after removal of *Mus* must have been greater than shown

	Dates	No. of nights observed	Records of *P. maniculatus*		
			No. mice	No. records	Records/ night
Before removal of *Mus*	June 20 – July 10	18	4	4	0.22
During removal of *Mus*	July 11-12	2	5	5	2.50
After removal of *Mus*	July 13 – August 14	28	14	83	2.96
During removal of *P. maniculatus*	August 15-16	2	14	14	7.00
After removal of *P. maniculatus*	August 17-24	8	1	1	0.12

populated there must be frequent dispersal from areas such as the ravine. Most of the area may be too hot and dry at times for these mice to survive, but during much of the dispersal season (early summer) the entire region was cool and wet. This species can exclude *P. maniculatus*, at least under some conditions, and it is probable that it is absent from most habitats here because they are perceptually unsuitable.

The excellent supply of food and cover in and around some of the ranch buildings permitted *Mus* and *P. maniculatus* to build up dense populations, *Mus* by breeding and *P. maniculatus* by breeding and immigration. Both food and cover occurred in scattered patches (usually the buildings) surrounded by less favorable habitat, producing even greater concentrations of mice. This apparently led to partial breakdown of the territorial dispersion pattern that is characteristic in more uniform habitats (Crowcroft and Rowe, 1963; Sheppe, 1966b). Much fighting occurred and a hierarchical social structure may have developed.

The great increase in use of the feed shed by *Peromyscus* after the removal of *Mus* seems to confirm the hypothesis that in some way *Mus* had kept *Peromyscus* from using the shed. The mechanism of this effect is not known. *Mus* may have attacked *Peromyscus* and driven them off, or *Peromyscus* may merely have avoided the shed because so many *Mus* were there. It was not possible to observe the mice directly, but there are several indications that there was actual conflict between the species. One smoked card apparently records a fight between *Mus* and *Peromyscus*. The many tail scars of *Peromyscus* on Line 1 probably were received in fights with *Mus*.

King (1957) conducted laboratory studies of fighting in *Peromyscus maniculatus bairdii* (Hoy and Kennicott) and an inbred strain of *Mus*. In intraspecific encounters *Mus* was more aggressive than *Peromyscus* and when the two species were paired *Mus* repeatedly attacked *Peromyscus*, which adopted a defense posture or tried to escape. He concluded that when popula-

tion density is high *Peromyscus* probably would be replaced by *Mus*. In the present study *Peromyscus* was found everywhere except in the place where *Mus* was most abundant.

Where two species are in competition for the use of an environmental resource the outcome will be influenced by the exact conditions of competition. In suitable habitat such as the feed shed *Mus* has several advantages over *Peromyscus*: (1) it is more aggressive; (2) in spite of this, it tolerates a much greater population density; (3) in such habitats *Mus* seems to maintain more stable home ranges than *Peromyscus* and therefore may be more resistant to being forced out; (4) *Mus* occupies a much smaller home range. The last means that it can defend every part of its home range more easily than *Peromyscus* can. It may also be that because *Peromyscus* occupies such a large area it will be less likely to defend any part of it, tending to enter only areas where it does not encounter competitors.

It is probable that under some conditions *P. maniculatus* is competitively superior to *Mus*. There is little direct evidence that this was true anywhere on the ranch, but the confinement of *Mus* to such a small area may have resulted in part from the presence of *P. maniculatus* in surrounding areas that were less well suited to *Mus*. The ranch house should have been excellent habitat for *Mus*, with abundant food and cover, but it was never found there. It was found occasionally in the sawdust shed a short distance away and it may be the *P. maniculatus* kept it out of the house.

The relation between *Mus* and *Peromyscus polionotus* (Wagner) in old-field habitats in South Carolina is very different from that observed at the ranch (Caldwell, 1964; Caldwell and Gentry, 1965). These fields are marginal habitats for *Mus*, and whereas *P. polionotus* maintains large populations with stable home ranges *Mus* is fugitive, able to coexist with *Peromyscus* only because competition can be relieved by emigrating. Some of this apparent emigration of *Mus* may have been caused by trap avoidance similar to that observed in this study, which Caldwell had no way of detecting. These species did not interact aggressively in the field or the laboratory. If *Mus* could maintain a stable population in an unenclosed field that was kept free of *P. polionotus* this would provide additional support for the theory that the presence of *P. polionotus* affected *Mus* adversely.

The failure of additional *P. maniculatus* to use the feed shed after the removal of those that had been using it was unexpected, in view of the results after the removal of *Mus* and the results of studies with *P. leucopus* (Sheppe, 1966b). Presumably many of the mice that were living nearby either did not know of the shed or did not know that the other mice had been removed. There must have been little social pressure in the population at that time, and the food supply in other parts of the area must have been good.

A great deal has been written about how much the niches of two species must overlap for competitive exclusion to occur, but under some conditions this question may be irrelevant. Competition may be divided into primary competition for resources that are in short supply and secondary competition — some type of negative interaction not directly related to a resource in short

supply, between individuals or species with similar niches. Primary competition is for food, nest sites, attachment sites, etc. Secondary competition includes direct interactions such as territoriality or mutual intolerance. Its effect on distribution may be immediate, whereas the effect of primary competition usually is expressed more slowly, perhaps over many generations.

In the higher animals primary competition is replaced by secondary, which may have evolved because it tends to prevent primary competition. The relation between *Mus* and *Peromyscus* in the feed shed apparently was one of secondary competition. They used one resource, food, in the same way, but for immediate purposes there was abundant food for both species. *Peromyscus* apparently did not use another resource, nest sites, that *Mus* used. *Mus* excluded *Peromyscus* by social interaction, not by more efficient utilization of a resource, and whether the two species had identical niches was irrelevant to the outcome of their competition. Some workers might prefer to define competition more narrowly and say that in the feed shed social interference prevented competition.

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I am deeply grateful to Mr. and Mrs. Pat Wright for permitting this work to be done on their ranch, and for providing living quarters and other help. I am also grateful to Dr. L. D. Caldwell and Dr. O. P. Pearson for reading an earlier version of the manuscript.

SUMMARY

1. Mouse populations were studied for two months in the summer of 1965 on a ranch at the eastern edge of the Cascade Mountains in British Columbia. Observations were primarily by livetrapping and smoked paper tracking.

2. A wooded ravine had been occupied exclusively by an isolated population of *Peromyscus oreas* until this population was removed in 1957. In the next two years the ravine was occupied exclusively by *P. maniculatus*. In 1965 it was again occupied exclusively by *P. oreas*, supporting the conclusion that *P. oreas* excluded *P. maniculatus* from the ravine.

3. The ranch buildings were occupied by large numbers of *P. maniculatus* and *Mus musculus*. *Mus* was found only in and around the buildings. *P. maniculatus* was found throughout the region, but at much higher density in the buildings than elsewhere. It occupied larger and less stable home ranges than *Mus*.

4. Both species usually show a territorial social organization, but in these buildings there was broad overlap of home ranges and the social organization probably was hierarchical.

5. Both species reproduced in the spring. Reproduction had virtually ceased in *P. maniculatus* when the study began, and was not resumed. It continued in *Mus* into July, by which time the population was almost extinct.

6. The distribution of these species among the buildings overlapped broadly, but each species was most abundant in places where the other was least abundant, suggesting mutual exclusion. A high per cent of *P. maniculatus* in the buildings had tail scars, probably obtained in fights with *Mus*.

7. *Mus* was most abundant in a feed shed, where there was much food and cover. *P. maniculatus* was rarely recorded there. To test the hypothesis that *Mus* was excluding *P. maniculatus* most of the *Mus* were removed. *P. maniculatus* immediately began to visit the shed regularly, confirming the hypothesis.

8. *P. maniculatus* continued to visit the feed shed regularly for a month, after which all mice were removed from the shed. In the next week the shed was visited only once, by a *P. maniculatus*, although this species was abundant in surrounding areas. The reason for this failure to use the best food supply on the ranch is not known.

9. These results indicate that the habitat distribution of the mice on the ranch is determined in part by competitive exclusion, in addition to the survival and perceptual characteristics of the habitats.

REFERENCES

BRAYSHAW, T. C. 1965. The dry forest of southern British Columbia. pp. 65-75 *in* V. J. Krajina, editor, Ecology of western North America, v. 1. Vancouver: University of British Columbia. 112 pp.

CALDWELL, L. D. 1964. An investigation of competition in natural populations of mice. Journal of Mammalogy 45: 12-30.

CALDWELL, L. D. and J. B. GENTRY. 1965. Interactions of *Peromyscus* and *Mus* in a one-acre field enclosure. Ecology 46: 189-192.

CROWCROFT, P. and J. JEFFERS. 1961. Variability in the behaviour of wild house mice (*Mus musculus* L.) towards live traps. Proceedings of the Zoological Society of London 137: 573-582.

CROWCROFT, P. and F. P. ROWE. 1963. Social organization and territorial behaviour in the wild house mouse (*Mus musculus* L.). Proceedings of the Zoological Society of London 140: 517-531.

DAVIS, D. E. 1955. Social interaction of rats as indicated by trapping procedures. Behaviour 8: 335-343.

KING, J. A. 1957. Intra- and interspecific conflict of *Mus* and *Peromyscus*. Ecology 38: 355-357.

SHEPPE, W. A. 1961. Systematic and ecological relations of *Peromyscus oreas* and *P. maniculatus*. Proceedings of the American Philosophical Society 105: 421-446.

———. 1963. Population structure of the deer mouse, *Peromyscus*, in the Pacific Northwest. Journal of Mammalogy 44: 180-185.

———. 1965a. Island populations and gene flow in the deer mouse, *Peromyscus leucopus*. Evolution 19: 480-495.

———. 1965b. Characteristics and use of *Peromyscus* tracking data. Ecology 46: 630-634.

———. 1966a. Exploration by the deer mouse, *Peromyscus leucopus*. American Midland Naturalist 76: 257-276.

———. 1966b. Determinants of home range in the deer mouse, *Peromyscus leucopus*. Proceedings of the California Academy of Sciences 34: 377-418.

———. In press. The effect of livetrapping on the movements of the deer mouse, *Peromyscus leucopus*.

YOUNG, H., J. NEESS, and J. EMLEN. 1952. Heterogeneity of trap response in a population of house mice. Journal of Wildlife Management 16: 169-180.

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SOME WINTER ASPECTS OF THE GREAT GRAY OWL

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The winter of 1965-66 was notable for a large irruption of Great Gray Owls, *Strix nebulosa*, into parts of southern Ontario and southwestern Quebec. This flight penetrated southward to a line extending from Owen Sound, Presqu'ile Provincial Park, and Kingston, Ontario, and Dorval, Quebec; east at least to Cap Tourmente, Quebec; and west as far as Dryden, Ontario (Carleton, 1966; Goodwin, 1966).

In the Ottawa-Hull and Carleton Place areas there were confirmed records of at least fifteen individuals during the winter, and unverified reports of as many more. Our first definite record was at Carleton Place, Ontario, on January 12, 1966 by Douglas Findlay; the last on April 9 at Ramsayville by the writer. The greatest concentration was of three at Lucerne, near Hull, Quebec, reported by Ronald Pittaway.

Because so little has been published on the habits of this rarely observed owl the following observations, made in the area outlined above, seem noteworthy. The writer is most grateful to Ronald Pittaway, Aylmer, Quebec for permission to quote from the latter's excellent notes based on the observation of five individuals.

Field Appearance. Published descriptions and color plates do not show adequately the peculiar, almost luminous quality of narrow silvery white patches on the foreneck just under the facial disc, one on each side of the small black throat patch. These areas, while narrow, are surprisingly conspicuous in poor light and at long distances. They may well be functional. All individuals observed were tame. Also, they showed little fear of human habitations, often flying and perching near houses.

Habitat. Although the literature gives the impression that this is mainly a forest owl, it is by no means confined to forests when it wanders south in winter. Four of the five observed by Pittaway (MS.) as well as all three observed by the writer were in either sparse wood edges bordering open fields or were in weedy fields where posts, scattered small trees, or low bushes served as perches. One, repeatedly flushed during the two hours the writer spent photographing it, refused to leave the 120-acre field it frequented although there was extensive forest on two sides. Several other observers reported this owl in similar open places. One individual at Carleton Place, was usually seen in mixed woodland. The above ratio of about ten to one in favor of open habitats is perhaps not realistic because the owls are much more conspicuous in open places than in forests and the former are much more likely to be noted. The attraction to open bushy fields was obviously the meadow mouse, *Microtus pennsylvanicus*, a favorite food of this owl and present in somewhat larger numbers than usual at the time.

FORAGING. When alert for prey, the owl most frequently sits on a bush, post, or part way up a tree. As it watches and listens it turns its head from side to side and sometimes it peers intently toward the ground. When prey is detected, the owl flies directy toward and above its target. Often it hovers briefly before dropping to the ground, legs extended straight out to grasp its prey. The owl often remains on the ground for some time. The writer saw one remain almost motionless on the ground, except for frequent turning of the head, for seven minutes. Mice taken were eaten on the ground. Once, in deep soft snow, the wings and bulky feathers were spread out over a surprising area, looking at a distance like a rug with an owl's head on it! Another, observed by Pittaway, flew to the ground and sat on the snow at the edge of a snow-free area under a tree. It remained there for over twenty minutes, apparently hunting from the ground. Twice it jumped onto spots near by. Once it ran a few steps and pounced heavily on a bare spot. While on the ground it remained very active and alert, peering about.

In times of deep snow cover, at least, this owl seems to locate mice by ear. The writer saw one take a mouse by quickly dropping to the snow, legs extended fully, the thrust of the talons reaching to the ground under eight inches of soft snow (as shown later by the tracks). There were no mammal tracks on the surface. Pittaway (MS.) examined three prints left in the snow by Great Gray Owls as they plunged through a half-inch crust and reached far into the deep snow for prey. In one, a small spot of blood suggested a kill. Law (1960) also concluded that mice under the snow are located by ear.

DIURNAL ACTIVITY. Forbush (1927) says, "In the far north where the summer sun hangs in the sky nearly all night, this bird, adapting itself to circumstances, hunts by daylight, but in the more southern parts of its range it prefers dusk or darkness for its hunting".

Those we encountered wintering in the Ottawa area were likely to be active almost any time in the daylight hours. However, they were inclined to be less active in the middle of the day, dozing or preening during noon and early afternoon. At about 2 p.m. on a bright February day the writer saw one emerge from a woodland edge, fly out over a meadow, and catch a mouse. Pittaway observed one hunting very actively at noon on a January day. However, we both noted maximum hunting activity in the early daylight hours of the morning and in the second half of the afternoon. Between 7 and 7.30 a.m. on a February morning Pittaway watched one catch five mice.

We learned little about nocturnal activity. However, Pittaway saw one perched in a tree behind a house at about 7.15 p.m. on a February evening and he noted that it was still there about midnight.

WINTER TERRITORY. Individual Great Gray Owls seemed to set up winter territories and could usually be located in their respective territories day after day. Near Lucerne, Quebec, three established territories not far apart. Occasional clashes were noted by Pittaway. One late afternoon two owls that had been perched on telephone poles 150 feet apart flew toward each other

and clashed in mid-air using talons and wings. They emitted a short raspy squeal. After a short aerial battle they returned to their perches, then repeated the performance. Finally one got the better of the encounter and the other flew off.

On another occasion, about 5.30 p.m. on February 26, Pittaway watched one as it perched forty feet away. Another Great Gray Owl came flying toward the sitting bird and the latter gave a "short rasping call" followed shortly by a deep but not loud *Who-oo-oo-oo* which was repeated three times. This vocalization was apparently directed toward the flying bird which flew off in another direction.

FOOD. In agreement with Law (1960), the present writer observed this owl preying on mice only. Once several Black-capped Chickadees, *Parus atricapillus*, fed leisurely in the tree in which an owl was perched, one flitting from branch to branch within six feet of the owl, which paid them little attention. On this occasion it had eaten a mouse some ten minutes earlier.

One of these valuable owls was shot by a man who thought that it was destroying grouse and other game. Fortunately, through the kindness of Mr. A. E. Bourguignon, the writer was able to examine the dead bird. The stomach of this 'killer' owl contained, as expected, four meadow mice, *Microtus pennsylvanicus*.

REFERENCES

CARLETON, GEOFFREY. 1966. Hudson - St. Lawrence Region. Audubon Field Notes 20(3): 405.

FORBUSH, EDWARD HOWE. 1927. Birds of Massachusetts and other New England States. Massachusetts Department of Agriculture, Boston. Volume 2, pp. 1-461.

GOODWIN, CLIVE E. 1966. Ontario-Western New York Region. Audubon Field Notes 20(3): 417.

LAW, CLIFFORD. 1960. The Great Gray Owl of the Woodlands. The Blue Jay 18(1): 14-16.

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THE EFFECT OF PHOSPHAMIDON ON BIRD POPULATIONS IN JACK PINE STANDS IN QUEBEC

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During the course of a highly successful large-scale aerial spraying operation carried out against the Swaine jack-pine sawfly, *Neodiprion swainei* Midd., in the St. Maurice Valley, west of La Tuque, Quebec, (McLeod 1966) observations were carried out on the effect of the spray on bird populations in jack pine stands. Approximately 135,000 acres of jack pine forest were sprayed between August 10 and 20, 1965, utilizing the insecticide phosphamidon (2-chloro-2-diethlcarbamoyl-1-methylvinyl-dimethyl phosphate) applied at the rate of ¼ lb of technical insecticide in 0.2 gal of water per acre. Studies on the avifauna of jack pine stands had already been initiated in 1964 and since then have formed an integral part of a broad programme of studies on the population dynamics of the Swaine jack pine sawfly.

Two 18-chain square sample plots were used to census bird populations during and following the nesting season, one in an area which was designated to be sprayed, and the other in a control (non-sprayed) area. The control plot was censused in 1964 and 1965, and the sprayed plot in 1965 only. Both plots were established in pure 40- to 50-year-old jack pine stands of about 800 to 1000 stems per acre which were severely infested by the sawfly.

Census techniques consisted of walking parallel lines at 2-chain intervals in the plots and recording the positions, by species, of all birds seen or heard. The operation was usually performed by one observer plus an assistant who plotted the position of each bird on a grid map. A single census required 2.5 to 4 hours to complete, depending on the number of birds encountered. Each plot was censused intermittently from June until mid-September. Breeding populations were calculated by delimiting the territory of singing males and observed females of each species from plotted points on the grid in successive censuses. Each plotted territory was assumed to contain one breeding pair. After the nesting season (about the last week in July), adjustments in sampling techniques were required because of the break-up of definable territories and the banding together of large pre-migratory flocks consisting of a multiplicity of species whose numbers could not be calculated precisely. Consequently, during this period, only individuals and pairs were noted, and flocks were grouped in units of 5, 10, 25, 50, and 100 birds respectively.

Apparently, breeding birds are not particularly abundant in jack pine stands (Table 1). In contrast, Kendeigh (1947) reported populations of between 150 and 300 breeding pairs per 100 acres in deciduous, mixed-wood, or spruce-fir forests, more than double the densities observed in jack pine forests. The difference appears to be mainly due to the paucity of arboreal nesters, notably wood warblers, in jack pine stands. The characteristically open nature

Table 1.—Breeding birds in 18-chain-square plots in jack pine stands — St. Maurice Valley, 1964 and 1965. (Populations calculated prior to application of spray).

Species	Number of breeding pairs in plots		
	Plot V 1964	Plot V 1965	Plot II 1965
Slate-colored Junco	6	6	5
Myrtle Warbler	4	1	1
Hermit Thrush	4	3	4
White-throated Sparrow	2	1	1
Nashville Warbler	1	1	1
Brown-capped Chickadee	1	0	1
Ruby-crowned Kinglet	0	1	0
Spruce Grouse	1	0	0
Brown Creeper	1	0	1
Canada Jay	1	0	0
Total	21	13	14
No. of breeding pairs per 100 acres	62	40	43

of these forests and the small volume of foliage per unit area would probably inhibit maintenance of high populations in the trees. Also, a jack pine stand is essentially a monoculture, thus reducing the frequency of ecotones which would normally favour high bird populations and diversity of species.

The Myrtle and Nashville warblers were the only arboreal nesters consistently found in the study areas, and even these were not abundant. Both Fowle (1965) and Kendeigh (*op. cit.*) found that wood warblers and vireos comprised half or more of the total birds in spruce-fir forests. In jack pine stands, the ground nesting Slate-colored Junco, Hermit Thrush, and White-throated Sparrow, accounted for at least one half of all the breeding pairs (Table 1). The dense ground cover consisting mainly of *Kalmia angustifolia* L., *Vaccinium* spp., *Calliergon schreberi* (BSG.) Grout, and *Cladonia rangiferina* L. provides favourable protection and a plentiful supply of insects for ground nesting species, thus accounting for their relatively high abundance. Significantly, all the resident breeders are known to be predators on adult sawflies, as determined by analyses of the stomach contents of birds shot in the vicinity of the study areas. It would appear that the bulk of the bird predation on adult sawflies occurs before the insects leave the ground cover.

A marked change in the number and composition of bird species occurs shortly after the main breeding season is terminated by the third week in July. At this time, birds begin to coalesce into family units (flocks of the same species) or pre-migratory flocks (of more than one species). Some species, notably the Hermit thrush, and, to a lesser extent the Slate-coloured Junco and White-throated Sparrow, begin to move out of jack pine stands at this time. Others, including the Myrtle Warbler, Boreal Chickadee, Black-capped

TABLE 2.—Bird populations in two 18-chain-square plots in jack-pine stands calculated in two periods, before and after spraying with phosphamidon. Each period comprises five consecutive days of observation.

Species	Approximate number of birds observed					
	Unsprayed plot (Control)			Sprayed plot		
	Before spray*	After spray**	% change	Before spray*	After spray**	% change
Warblers	448	343	−23%	169	3	−98%
Others***	318	175	−45%	146	72	−51%
Total	766	518	−32%	315	75	−76%

*August 6 to 11 inclusive
**August 24 to 28 inclusive
***Chickadees, juncos, nuthatches, Hermit Thrush, sparrows.

Chickadee, Red-breasted Nuthatch, Ruby-crowned Kinglet, and Brown Creeper, in order of abundance, coalesce to form large mobile, pre-migratory flocks which persist in some stability in these stands until the latter part of September, when migration commences. Myrtle Warblers usually comprise over half the total number of birds in these flocks whereas other warblers such as the Blackburnian, Nashville, Tennessee, and Bay-breasted usually make up only a small proportion. These flocks are very active, almost constantly on the move in the morning hours until about 11:00 a.m. and again in the late afternoon. They appear to break up into progressively smaller units starting about 11:00 a.m.; little activity occurs in the early afternoon then the flocks begin to coalesce again. Since the flocks are made up of diverse species of varying feeding habits, all levels of the tree crowns as well as the ground vegetation are actively searched for insects. Most of these species ar predators of mature Swaine jack-pine sawfly larvae.

Thus when the study area was sprayed on August 15, 1965, very few breeding pairs remained in the plot and the premigratory flocks had assembled. Determination of the effect of the spray on the survival of birds was more difficult than it would have been had the spray been applied during the breeding season (Fowle, *op. cit.*) because males were not singing, and the size and mobility of the pre-migratory flocks made it difficult to obtain accurate counts. To assess the effect of the spray on bird survival, each plot was censused once each day for a 5-day period before (August 6 to 11 inclusive) and after spraying (August 24 to 28 inclusive) (Table 2). In addition, roads were travelled in six widely separated areas shortly following application of spray, where notes were made on the behaviour of birds and attempts were made to collect dead or sick birds (Table 3).

Table 3.—Dead and sick birds recovered during searches of roadsides and forests in phosphamidon-sprayed areas.

Species	Number found	
	Dead	Sick*
Myrtle Warbler	2	6
Nashville Warbler	0	2
Blackburnian Warbler	0	1
Slate-colored Junco	3	0
Ruby-crowned Kinglet	1	0
White-throated Sparrow	0	2
Yellow-bellied Flycatcher	0	1
Spruce Grouse	1	0
Unidentified (probably warblers)	7	0
Total	14	12

*All but one of the sick birds (a Myrtle Warbler) died shortly after capture. Birds exhibited such symptoms as fluttering, lack of co-ordination, and lengthy periods of sluggishness.

It became apparent during the roadside observations that the spray was exhibiting a marked effect on bird populations. Before spraying, large pre-migratory flocks sometimes of 50 to 100 plus birds could often be seen. They were usually strongly coalesced, the individual birds rapidly searching the foliage for insects, and emitting frequent strong calls. After spraying, few large flocks were seen, the absence of warblers was striking, only feeble calls were heard, and dead or sick birds were recovered from within the sprayed areas (Table 3).

The population counts in the two sample plots supported these observations (Table 2). In spite of the apparent differences in the pre-spray populations, it is evident that the application of the spray resulted in a significant ($P < 0.05$) overall reduction of bird populations in the sprayed plot. Particularly notable was the reduction in the number of warblers ($P < 0.05$); other species were, as a group, not significantly reduced in numbers in the sprayed plot. When pre-migratory flocks did reform in sprayed areas in the weeks following application of the spray, the great majority consisted of chickadees, juncos, and nuthatches. Warblers, notably the Myrtle Warbler, were usually absent.

One can infer from this information that some birds, mostly warblers, must have died following the application of the spray, and others emigrated. Warblers did not repopulate sprayed areas in number until migration was well underway. Presumably the application of phosphamidon had a deleterious effect on bird populations, but the nature and extent of the effect was not determined. Tests with reduced phosphamidon dosages (ca. ⅛ lb/0.2 gal/acre) proved almost equally effective against the sawfly (McLeod, *op. cit.*), a factor which should in future reduce the amount of bird mortality in aerial spraying operations against the Swaine jack-pine sawfly.

Studies on the avifauna of jack pine stands will be continued in future with emphasis laid on the determination of the functional and numerical responses of avian predators to changes in sawfly density. Also, studies on bird survival following aerial spraying operations will continue to be an integral part of studies on the ecology of the Swaine jack-pine sawfly.

REFERENCES

FOWLE, C. D. 1965. A preliminary report on the effects of phosphamidon on bird populations in central New Brunswick. Canadian Department of Northern Affairs and National Resources, Canadian Wildlife Service, Occasional Paper No. 7. 54 pp.

KENDEIGH, S. C. 1947. Bird population studies in the coniferous forest biome during a spruce budworm outbreak. Ontario Department of Lands and Forests, Biological Bulletin 1:1-100.

McLEOD, J. M. 1966. Aerial spraying operations against the Swaine jack-pine sawfly in Quebec, 1965. Canadian Department of Forestry, Bi-Monthly Progress Report 22 (1):1-2.

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HERPETOLOGICAL OBSERVATIONS IN SASKATCHEWAN AND THE MACKENZIE DISTRICT

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DURING the summer of 1966 the author had the opportunity of accompanying an expedition to central Canada for the purpose of collecting arctic and subarctic mites and insects (NSF No. GB 3369). Travelling was done by vehicle from Regina to Prince Albert, Saskatchewan on June 25 to June 28. June 29 and 30 were spent in northern Saskatchewan at the small town of Stony Rapids. On July 1 our party was flown into Wholdaia Lake, Mackenzie District, Northwest Territories. From this point we travelled by canoe for two months before reaching our destination at Aberdeen Lake, Keewatin District, Northwest Territories. This transect traversed prairie, aspen parkland, boreal forest, and tundra. Notes were taken and collections made of the amphibians and reptiles encountered on the trip. Figure 1 indicates the collecting localities mentioned in this paper. There is very little herpetological literature from this region, especially from the northern parts. This report is a summary of observations in this area.

Rana sylvatica — Three populations of this species were encountered. The first population was found in a temporary roadside pool about eight miles south of Prud'homme, Saskatchewan. This species was present at Stony Rapids, but was not found in the area of Wholdaia Lake. Hinde Lake, 25 miles north of this spot, had *sylvatica* floating at the edge of the lake on July 8. This was the last sign we had of any amphibian population on the canoe trip. Stony

Rapids was again visited on August 31, 1966, and at that time there were no signs of any adult frogs or tadpoles present in the area.

The southern distribution of this species agrees well with the observations of Cook (1965). Prud'homme is located at the edge of the grassland-aspen zone. The records cited by Cook tend to follow this transition zone. The most northern population previously recorded from this transect had been from Hasbala Lake, Saskatchewan (59°58'N, 102°03'W) by Nero and Cook (1964). Hinde Lake (61°12'N, 103°40'W) is situated approximately 85 miles north of this locality. The absence of *sylvatica* from the area around Wholdaia Lake might be explained by the fact that this area, although within the "tree line", had large patches of tundra present and a permafrost level less than a foot beneath the surface. Hinde Lake, on the other hand, had a rich boreal forest cover, and permafrost was not encountered although a hole about two feet deep was excavated.

Some data is available on the reproductive behavior of these populations. No eggs or tadpoles were seen at Prud'homme. Of two adult animals that were preserved from this locality, the lone female did not contain eggs. Tadpoles of *sylvatica* were collected at Stony Rapids. Two specimens measured (after preservation) 26 and 35 mm total body length. Five out of seven adult animals preserved from this spot turned out to be females. Only one of these had any mature eggs. There were no signs of eggs or tadpoles in the northernmost locality. Five of the seven animals collected there were female, with no evidence of eggs in the oviducts.

Shortly after capture measurements and color slides were taken of the frog samples. Table 1 summarizes the characteristics of the three populations. There is no indication of a reduction in the tibia/body length ratio as one goes further north in this transect. Martoff and Humphries (1959) have summarized the various variations within the *Rana sylvatica* populations. Only the Stony Rapids sample agrees with their classification as regards body length, dorsal stripe presence, and tibia/body length ratio. Prud'homme animals have a greater number with a middorsal line, and a larger body length than expected on the basis of Martoff and Humphries' classification. The Hinde Lake sample should fall within their Alaskan type with a body length less than 40 mm, a dorsal stripe present on over 50% of the animals, and a tibia/body length ratio less than .475. The actual data only agree with two of these characters. Two other northern populations have been reported in the literature: one from Hasbala Lake (Cook, 1965) and one from northern Manitoba and southern Keewatin District (Harper, 1963). Two out of nine animals of Cook's sample and none of the four animals from Harper's sample had a dorsal stripe present. Both these samples had a greater mean body length than that predicted by Martoff and Humphries. It therefore appears that at least in the north central range of *sylvatica* in Canada, the animals are characterized by a low incidence of the middorsal stripe, and a variable body length.

Pseudacris triseriata maculata — This species was heard chorusing from roadside ponds from Regina to Prince Albert. A sample was taken at Davidson, Saskatchewan on June 25. In addition three animals were collected at Stony

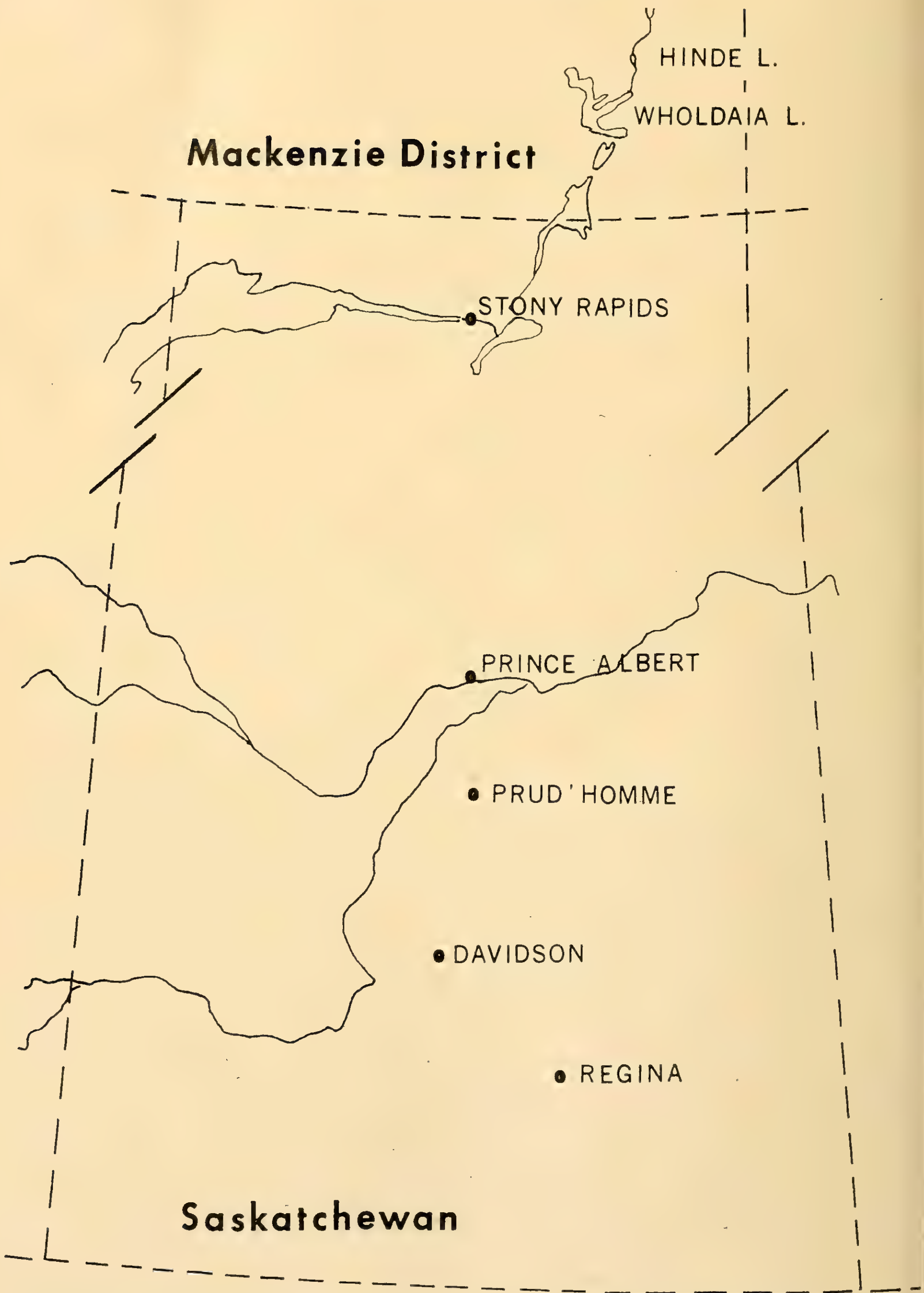

FIGURE 1. Collection localities of amphibians and reptiles in Saskatchewan and the Mackenzie District — summer 1966.

TABLE 1.—Summary of measurements of *Rana sylvatica* collected in Saskatchewan and the Mackenzie District during June, July 1966

Locality and Sample Size	Average Tibia/Body Length Ratio	Percent with Dorsal Stripe	Body Length
Prud' homme–11	.436	54.3	40.2 mm (34–56)
Stony Rapids–11	.441	82	36.6 mm (31–44)[a]
Hinde Lake–7	.445	0	38.0 mm (30–45)

[a] = does not include animal of body length 27 mm.

Rapids on June 29. No animals were seen or heard on the canoe trip. Logier and Toner (1961) do not show any records of this species for northern Saskatchewan.

Tadpoles were found at Davidson. Five tadpoles measured after preservation 5, 8, 9, 28, and 29 mm body length. Of the 11 animals collected at this locality, 10 were males. The lone female contained eggs. There was no evidence of tadpoles of this species at Stony Rapids.

Little can be said about the geographic variation of *Pseudacris triseriata maculata* from this small sample. There does not seem to be any change in size or reduction in the tibia/body length ratio between the Davidson (11 animals) and Stony Rapids (3 animals) frogs.

Thamnophis radix haydeni — Only one reptile was seen on the transect. This individual was captured at Prud'homme on June 26 while it was swimming in a roadside ditch. It measured a snout-vent length of 230 mm and tail length of 65 mm.

This entire sample of animals has been deposited in the collection of the Los Angeles County Museum.

ACKNOWLEDGEMENTS

I would like to thank Dr. Donald Chant for the opportunity to accompany this expedition and for his help during the trip. Acknowledgements are also due Mr. Roger Hansell and Dr. Jame Chillcott, who helped with the collections.

REFERENCES

COOK, F. R. 1965. Additions to the known range of some amphibians and reptiles in Saskatchewan. The Canadian Field-Naturalist 79(2):112-120.

HARPER, F. 1963. Amphibians and reptiles of Keewatin and northern Manitoba. Proceedings of the Biological Society of Washington 76:159-168.

LOGIER, E. B. S. and TONER, G. 1961. Checklist of the amphibians and reptiles of Canada and Alaska. Second edition. Royal Ontario Museum, Life Sciences Division, Contributions 53:1-92.

MARTOFF, B. S. and HUMPHRIES, R. L. 1959. Geographical variation in the wood frog *Rana sylvatica*. American Midland Naturalist 61(2):350-389.

NERO, R. W. and COOK, F. R. 1964. A range extension for the wood frog in northeastern Saskatchewan. The Canadian Field-Naturalist 78(4):268-269.

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STUDIES OF THE BYRON BOG IN SOUTHWESTERN ONTARIO. XXVIII. DISTRIBUTION OF CLUB-MOSSES AND FERNS

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THE BYRON BOG has been described by Judd (1957). It lies in a hollow at the southwest corner of Oxford Street and Hyde Park Road in London, Ontario. There are three vegetation zones, A, B, and C (Fig. 1). The central part is a mat of floating *Sphagnum* moss (Zone A). Surrounding this is an expanse of low woods, permanently damp or flooded (Zone B). The outer rim of the bog consists of dry, wooded slopes (Zone C). In the floating bog is Redmond's Pond (D). An account of some of the plants characteristic of the three zones is given by Judd (1957), an account of the succession and duration of blooming of some plants is given by Judd (1958), and an account of the distribution of shrubs and vines is given by Judd (1966). The present account concerns the distribution of club-mosses and ferns.

The chief sources of information were observations and collections made in the bog by the writer from 1956 to 1966. Specimens thus collected are in the writer's herbarium. Other specimens are in the herbarium of the University of Western Ontario and were collected by Mr. W. D. Sutton and Mr. Eli Davis. Mr. Sutton, Director of Education for the London Board of Education, collected specimens in 1936. The locality of his specimens is given as "Foster's Swamp", a name formerly applied to the bog when it was owned by Mr. Thomas Foster who farmed in London Township. Mr. Davis collected specimens in 1931 and 1936. For many years he operated a market garden and greenhouse south of the bog and has long been interested in various aspects of local natural history. The locality of his specimens is given as the "Spruce Swamp", another name formerly applied to the bog, particularly by members of the McIlwraith Field-Naturalists' Club, London's local natural history club. Identifications of the club-mosses and ferns were made by using keys and descriptions in Cobb (1963), Cody (1956) and Fernald (1950) and by comparison with specimens in the herbarium of the University of Western Ontario.

The following annotated account lists three species of club-mosses and eight species of ferns found in the bog. The accompanying numbers are shown on the map to indicate the distribution of the various species. The accession numbers of specimens in the writer's herbarium are noted, ranging from 651 to 734.

Lycopodiaceae

1. *Lycopodium lucidulum* Michx., SHINING CLUB-MOSS. This species is present in patches varying in area from two square feet to several square yards in the easterly part of Zone B in the shade of trees, particularly white pine. A specimen (651) collected on April 26, 1965 bears reniform yellow sporangia in the axils of the shorter leaves. Mr. Sutton collected a specimen on April 13, 1936.

2. *Lycopodium inundatum* L., BOG CLUB-MOSS. The only specimens available are several strobile-bearing branches collected by Mr. Davis on October 25, 1936. Mr. Davis recalls that they were collected in the damp

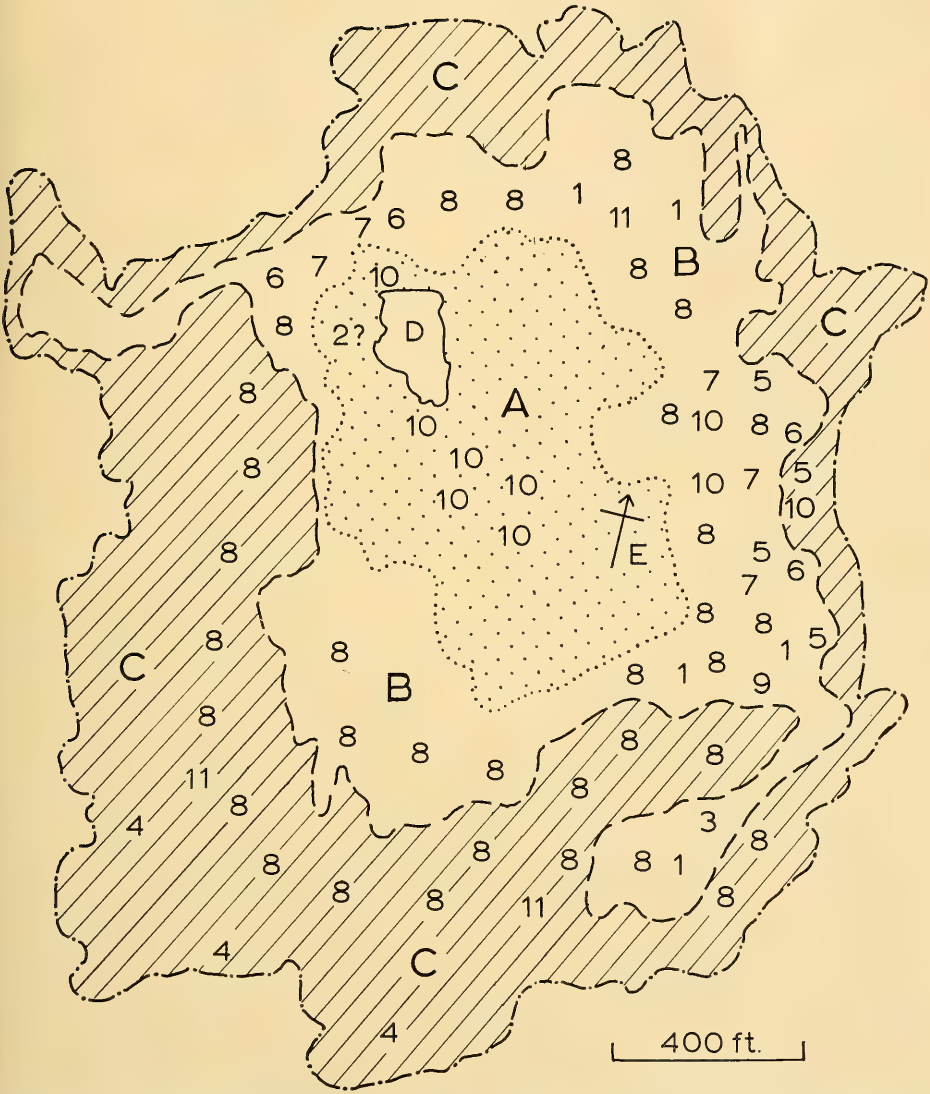

FIGURE 1. A — floating bog; B — lower, damp woods; C — wooded slopes; D — Redmond's Pond; E — location of co-ordinate point 42° 58′ 15″ N 81° 19′ 15″ W.

Sphagnum moss in Zone A west of Redmond's Pond. On September 6, 1966 Mr. Davis and I examined this area as well as other parts of the bog but found no specimens.

3. *Lycopodium obscurum* var. *dendroideum* (Michx.) D. C. Eaton, ROUND-BRANCHED GROUND-PINE. Only one patch, about one square yard in area, was located in deep shade in the southeast part of Zone B. A specimen (692) collected on September 7, 1966 bears no strobili.

Ophioglossaceae

4. *Botrychium virginianum* (L.) Sw., RATTLESNAKE-FERN. This fern occurs as scattered plants on the shaded but dry upper

slopes of southwest Zone C. A specimen (725) collected on June 2, 1966 is one foot tall, including a fertile blade three inches long.

Osmundaceae

5. *Osmunda regalis* L., ROYAL FERN. This species occurs in luxurious growth along a low trough of terrain in the easterly part of the border between Zones B and C. Open water is present in this trough through the spring and into July. After this the water dries up slowly but the mud remains damp. The plants grow in the shade of black spruce and hard-wood trees and some achieve a height of six feet. A plant from which a specimen (724) was taken on June 2, 1966 was two feet tall.

6. *Osmunda cinnamomea* L., CINNAMON-FERN. Several widely-spaced plants are present in the northwest part of Zone B and a few are interspersed among plants of royal fern in the easterly part of Zone B. A specimen (730) collected on September 4, 1966 included a curled and drooping fertile frond.

Polypodiaceae

7. *Onoclea sensibilis* L.,SENSITIVE FERN. This fern is commonest, in company with royal fern, along the low trough at the easterly part of the border between Zones B and C. A few plants occur in the northwest part of Zone B. Specimens collected (723) on June 2, 1966 included a sterile frond of that year and a fertile frond of the previous year.

8. *Dryopteris spinulosa* (O. F. Muell.) Watt, SPINULOSE WOOD-FERN. This is the commonest fern in the bog, being present throughout Zone B where its growth is most luxuriant in the southeast part of this zone, with fronds up to two and a half feet long. It also grows on the lower, shallow slopes of the west and south parts of Zone C. A specimen (726) collected on June 30, 1966 had black sori with indusia intact. After June the sori on fronds were brown and the indusia shrivelled on most plants examined, except for one plant, examined on September 18, 1966, on which one frond bore fresh green sori and another bore black sori with indusia intact. All plants examined were typical *spinulosa* with basal inferior pinnules slightly longer than the second inferior pinnules (Cobb, 1963). Four herbarium sheets of this species were collected by Mr. Davis on November 2, 1931.

9. *Dryopteris cristata* (L.) Gray, CRESTED WOOD-FERN. A few plants grow among plants of spinulose wood-fern in the southeast part of Zone B. Specimens (734) were collected on October 21, 1966.

10. *Thelypteris palustris* Schott, MARSH-FERN. This is the only fern found on the open bog, Zone A, where it shows its most extensive and luxuriant growth in sodden *Sphagnum* moss south of Redmond's Pond. Some growth occurs also along the border between Zones A and B north of Redmond's Pond and, more sparsely, among royal and sensitive fern in the easterly part of Zone B. Sterile fronds were collected on June 30, 1966 (727). A fertile frond collected on August 15, 1966 (728) bore green sori and a frond collected on September 4, 1966 (729) bore brown sori producing masses of spores.

11. *Athyrium filix-femina* (L.) Roth, LADY-FERN. A few plants are present on the lower, shaded slopes in southeast Zone C. Specimens collected here on September 6, 1966 included a sterile frond (731) and a fertile frond (732). One plant examined on October 14, 1966 (733) in northeast Zone B was of the "upland" type (Cobb, 1963) with the two lower leaflets small and drooping. A large robust plant on the lower slopes of southwest Zone C on October 14, 1966 was of the form *rubellum* (Gilbert) Farw. with wine-coloured stalks (Cobb, 1963).

On October 14, 1966, after a few light frosts since the end of September, the sensitive fern was brown and crumpled against the ground, the sterile fronds of cinnamon-fern and royal fern were still upright but yellowing, the fronds of lady-fern were drooping but still green, the fronds of marsh-fern were stiff and upright but brown and with curled pinnae, and only the spinulose wood-fern and crested fern were still green and upright. On October 21, after further frosts, all ferns but spinulose wood-fern and crested fern were brown and crumpled. The first snowfall of the season occurred on November 2, leaving three inches of snow on the soil of the bog and soggy clots of snow

on the sagging branches of black spruce. The fronds of crested fern were weighed down beneath the snow while the majority of fronds of spinulose wood-fern remained green and upright above the snow.

REFERENCES

COBB, B. 1963. A Field Guide to the Ferns and Their Related Families. Houghton Mifflin Co., Boston. xviii, 281 pp.

CODY, W. J. 1956. Ferns of the Ottawa district. Canada Department of Agriculture, Publication 974. 94 pp.

FERNALD, M. L. 1950. Gray's Manual of Botany. 8th edition. American Book Co., New York. lxiv, 1632 pp.

JUDD, W. W. 1957. Studies of the Byron Bog in southwestern Ontario. I. Description of the bog. Canadian Entomologist 89(5): 235-238.

————. 1958. Studies of the Byron Bog in southwestern Ontario. II. The succession and duration of blooming of plants. The Canadian Field-Naturalist 72(3): 119-121.

————. 1966. Studies of the Byron Bog in southwestern Ontario. XXVI. Distribution of shrubs and vines. Michigan Botanist 5(2): 51-56.

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A VARIETY OF *TIMMIA* (*MUSCI*) NEW TO NORTH AMERICA

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Timmia norvegica Zett., a rare moss of northern and arctic distribution in North America, is characterized by its blackish-red leaf sheaths, hyaline at the extreme base and papillose at back toward the shoulders, and also by a mammillose-roughening at the back of the costa from the shoulders to the leaf apex. Sayre, in Grout's *Moss Flora of North America* (1935), recorded its range in the Western Hemisphere as Greenland, northern Ellesmere Island, and "Athabasca" (presumably some part of north-central Canada). It has also been reported from Port Clarence (Arnell, 1917), Wiseman (Sherrard, 1955), and Mt. McKinley National Park (Sherrard, 1957; Persson & Weber, 1958) in Alaska and from the Melville Peninsula (Hesselbo, 1937), Cornwallis Island (Steere, 1951; Persson & Holman, 1961), and Victoria and Southampton Islands (Persson & Holmen, 1961) in the Canadian Arctic. Judging from various sources in the literature, the species also occurs in northern and central Europe and Asia in arctic-alpine patterns of disjunction. Steere (1954) considered

T. norvegica one of a small but significant group of truly arctic mosses and summarized its distribution, without supporting data, as follows: arctic Alaska, the Canadian Eastern and Western Arctic, Ellesmere Island, East Greenland, Jan Mayen, northern Scandinavia, Novaya Zemlya, and the Yenisei and Lena regions of Siberia. I have seen specimens from Spitsbergen, Norway, Sweden, Poland, and Kazakstan (in central Asia), Greenland, arctic Alaska, Ward Hunt and Cornwallis Islands, Churchill, Belcher Islands, and Colorado.

Steere (1951), in reporting 14 collections, mostly admixtures found with other mosses, from Cornwallis Island, said, "Some specimens are very robust, and because of the papillose costa, on the dorsal side, as well as the large papillae on the leaf sheath, match rather well the description of *T. comata* Lindb. & Arnell. I have not seen any material of the Siberian species, however. . ." From these comments, it is clear that Steere's reports belong to *T. norvegica* rather than to *T. comata*, which is actually smaller and has narrower leaves about 3-4 mm long, smaller leaf cells (about 6-7 μ wide), and costae very obscurely toothed near the apex but otherwise smooth at back (though frequently mammillose on either side near the base of the limb). In *T. norvegica*, by contrast, the leaves are 5-7 mm long, with cells 9-13 μ wide, and the costa is distinctly mammillose at back above the sheath.

I recently discovered a specimen from northern Quebec which is clearly referable to *T. comata*. The specimen bears the following information as to provenience: falaise calcaire humide dans le bois, Ile Manitounouk, Lac Mistassini, *Jacques Rousseau 1847* (in herb. MICH as *T. megapolitana*). Further search yielded two other collections, from Alaska: On silt bank, on bluff, East Oumalik, *W. C. Steere 15425* (in herb. MICH as *T. norvegica*), and Chena River, *O. J. Murie*, July 19, 1922 (in herb. MICH as *T. megapolitana*). I have seen European specimens from Finland, Norway, and Sweden, as well as a collection from Disko Island, Greenland. According to Nyholm (1960), *T. comata* is also found in Switzerland and the USSR (presumably northern Russia). The type is from Siberia.

Although easily recognized, *T. comata* is obviously related to *T. norvegica* and bears the same degree of relationship to that species as *T. bavarica* does to *T. megapolitana*. In both cases, the differences are mainly quantitative, suggesting a small degree of speciation through polyploidy. I feel that, like *T. bavarica*, *T. comata* deserves only varietal status:

Timmia norvegica Zett. var. **comata** (Lindb. & Arn.) n. comb. *T. comata* Lindb. & Arn., K. Sv. Vet.-Akad. Handl. 23(10):24. 1890. *T. elegans* Hag., Nyt Mag. Nat. 38:338. 1900.

A word on the distributions of the other species of *Timmia* known from North America seems appropriate here, in so far as I have been able to confirm them: *Timmia austriaca* Hedw. – Greenland, throughout the Canadian Arctic and Alaska south to Utah and, disjunctively, in the Lake Superior region (Michigan) and the Gaspé Peninsula of Québec; northern and central Europe.

Timmia megapolitana Hedw. – Alaska, British Columbia, Alberta, and Saskatchewan, more common in the East, from Quebec to Manitoba and south to Nebraska, Arkansas, and Virginia; northern and central Europe, Siberia, and Japan. *Timmia megapolitana* var. *bavarica* (Hessl.) Brid. – Greenland, Alaska south to Arizona and as a disjunct in the Thunder Bay District of Ontario (*C. E. Garton 4296*, in herb. CAN), as well as northern and central Europe, the Caucasus, and central Asia.

REFERENCES

ARNELL, H. W. 1917. Die Moose der Vega-Expedition. Arkiv før Botanik 15 (5):1-111.

HESSELBO, A. 1937. Mosses collected on the Fifth Thule Expedition. Report of the Fifth Thule Expedition 1921-24, 2(2):1-17. Copenhagen.

LINDBERG, S. O. and H. W. ARNELL. 1890. Musci Asiae Borealis II. Laubmoose. Svenska Vetenskapsakadamien Handlingar 23(10):1-163.

NYHOLM, ELSA. 1960. Illustrated Moss Flora of Fennoscandia. II. Musci. Fasc. 4. Gleerups, Lund.

PERSSON, H. and K. HOLMEN. 1961. Bryophytes collected during the Arctic Field Trip of the Ninth International Botanical Congress. The Bryologist 64:179-198.

PERSSON, H. and W. A. WEBER. 1958. The bryophyte flora of Mt. McKinley National Park, Alaska. The Bryologist 61:214-242.

SAYRE, GENEVA. 1935. Timmiaceae. *In* A. J. Grout, Moss Flora of North America North of Mexico. Vol. 2, Pt. 3, pp. 145-149. Newfane, Vt.

SHERRARD, ELIZABETH M. 1955. Bryophytes of Alaska. I. Some mosses from the southern slopes of the Brooks Range. The Bryologist 58:225-236.

———. 1957. Bryophytes of Alaska. II. Additions to the mosses and hepatics of the Mt. McKinley region. The Bryologist 60:310-326.

STEERE, W. C. 1951. Bryophyta of arctic America. IV. The mosses of Cornwallis Island. The Bryologist 54:181-202.

———. 1954. The cryptogamic flora of the arctic. V. Bryophytes. Botanical Review 20(6/7):425-450.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. IV. *B. CAERULEA-GRANDIS* AND HYBRIDS

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This paper is one of a series dealing with Canadian birches grown from seed collected in various parts of Canada and now established in the Morgan Arboretum at Macdonald College, Ste. Anne de Bellevue, P.Q. This particular study concerns specimens of *Betula caerulea-grandis* Blanchard obtained from the three Maritime Provinces and from Eastern Quebec, though a number of other collections from along U.S. highway No. 2 in New Hampshire and Maine, were also studied. A number of putative hybrids with other *Betula* species have also been discerned. The collection has provided basic material for a study of juvenile characters and growth habits, and also serves as a basis for experiments in controlled crossings which should provide more exacting information on the relationships of these species. The maturation of some of our specimens of *B. caerulea-grandis* and *B. cordifolia*, which do not occur naturally in this area, will now make it possible to proceed with hybridization studies. Furthermore, we have recently secured a large collection of *B. caerulea-grandis* and *B. cordifolia* from Grand Manan Island, New Brunswick, which provides a population of adequate size for testing various hypotheses concerning the origin of *B. caerulea-grandis*. Since the results of these latter studies will not be available for some time, a review of the present status of this species should be useful.

Materials and Methods

The first collection recognized as *B. caerulea-grandis* in Canada was made by Blanchard at Sherbrooke, Quebec, in 1904 and is deposited in the Gray Herbarium, Harvard University. However, following Fernald's (1922) account of the occurrence of this species in the Maritime Provinces of Canada and at Montmorency Falls and in the Gaspé Peninsula in Quebec, a considerable period elapsed before it was again reported from Eastern Canada by D. S. Erskine (1960). He records this species as having been collected on the grounds of the Agricultural Experimental Station, Charlottetown, Prince Edward Island, in 1953 and suggests that it is of hybrid origin from a cross between *B. papyrifera* and *B. populifolia*. In 1960, Dr. E. C. Smith of Acadia University, also collected a specimen on the Noel Shore, Hants County, Nova Scotia, and in the same year the late G. C. Cunningham of the Department of Forestry, Fredericton, New Brunswick, and his associate Dr. O. L. Louckes,

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made extensive collections of this species in the Maritime Provinces. In the same year, and again in subsequent years, collections by the senior author made at the Forest Experimental Station, Valcartier, Quebec, have provided this species and a number of putative hybrids with other *Betula* species for study. In later years, the species has shown up at widely separated points, with wide gaps between. In 1964, the area and density of the distribution appeared to differ from that described by Fernald in 1922. In some cases the complex had changed. For example, *B. papyrifera* seems to have taken over areas once populated by *B. caerulea-grandis* and *B. cordifolia*, so that to-day there is a preponderance of young trees. It may be noted that the "die-back" that swept over this area in the thirties was particularly severe in the case of those species. On the Valcartier site all the regional tree birches are present: *B. papyrifera*, *B. populifolia*, *B. alleghaniensis* and *B. cordifolia*. In addition to the above mentioned material an examination has also been made of the original specimens of *B. caerulea-grandis* collected by Blanchard and preserved in the herbarium of the University of Vermont and the Gray Herbarium, Harvard University.

The morphological and cytological techniques used in our study have been given previously (Brittain and Grant, 1965a).

OBSERVATIONS AND DISCUSSION

A. *Betula caerulea-grandis* Blanchard

Blanchard marked a number of *B. caerulea-grandis* specimens "typical" and in a short description (Blanchard, 1904a) described *B. caerulea-grandis* as the "large blue birch" and stated that it occurs in abundance at Windham and Stratton, Vermont. Though marking several distinct collections as "typical", he does not specify any particular specimen as the type of this species. Therefore, we have designated one of the foregoing, labelled "Stratton, Windham Co., Vermont, Grant Pasture, July 17, 1903" as the type specimen. This specimen is in the herbarium of the University of Vermont at Burlington. Following is a brief description of this specimen which we have designated B-18 (Fig. 1):

> Stratton, Windham Co., Vermont. Large tree 40 meters high with thick white, separable bark. Branchlets smooth. Leaves glabrous, bluish green, lighter below, shallow cuneate at base with 38 to 50 serrations on each side and veins eight in number. Pistillate catkin cylindrical 3.2 × 1 cm. Bract 4-6 mm. long, with lateral lobes extending horizontally. Wing wider than achene which is 2.25 mm. long, 1.2 mm. wide, styles 1.25-1.6 mm. long, glabrous except for a few minute hairs at tip.

The following specimens in the herbarium of the University of Vermont were also examined. Three sheets, evidently representing the same tree, but taken on different dates (June 11, August 1, September 2) bear the notation "Windham, Vermont, Harrington Pasture, one half mile from Windham Village. Abundant, tree 20 feet high".

Blanchard also sent material to the Gray Herbarium, Harvard University, which includes the following four specimens, all labelled *B. caerulea-grandis*

and agreeing in essential details with the lectotype specimen described above. They were labelled by Blanchard as follows:

"*Betula caerulea-grandis* Blanchard, Windham, Vermont, Sept. 4, Aug. 1, 1903, 1,600 feet el., Blue Birch. The Windham stations are not on the Green Mountains as are the Stratton ones, but on the east slope of the Glebe Mountains which is 6 miles east of Green Mountains. Large fruited, large leafed. I could find but two trees in Windham in fruit of this form and they are small – not like the noble trees in Stratton – of 18 ft. as an example".

"*Betula caerulea-grandis* Blanchard, Stratton, Vermont. High ground, 1,900 feet, Blue Birch. Big leaved, big fruited. Big tree at least 60 feet high. *I climbed it.* Thick bark. Noble tree. Whole dump like it. Has a blue look. July 7, 1903". This is apparently the same tree as described above, designated number B-18.

"Typical *Betula caerulea-grandis* Blanchard, Windham, Windham County, Vermont: Harrington's pasture. August 1, 1903, one half mile north of Windham Vil. abundant in open pasture, leafy. This tree 20 ft. high".

"*Betula caerulea-grandis* Blanchard, Sherbrooke, P.Q." (Fig. 1, B-8).

Chromosome counts were made from seedling root tips of specimens collected at Charlottetown, P.E.I.; Guysborough, N.S.; Valcartier, P.Q. (45 specimens); and from Upton, Maine. All had a somatic chromosome number of $2n = 28$. None of these are the large trees "50 to 60 feet high" as described by Blanchard; most of them are not much more than 20 feet high and are relatively young trees.

In addition, herbarium specimens supplied by the late G. C. Cunningham provided the following sites in New Brunswick: Beaumont, Coles Island, Grand Manan Island, Acadia Federal Experimental Station, Lamaque, Summit Depot, St. Martins and Salmon River, and in Nova Scotia: Brier Island and Jackson, Cumberland County.

The following description of our Charlottetown specimen agrees in all details with Blanchard's specimens as well as with other Canadian material of this species.

Charlottetown, P.E.I., September 22, 1957 (No. 7). A single tree on the Agricultural Research Station grounds by the lily pond (see Fig. 1, No. 7). *B. pendula* Roth, and *B. papyrifera* Marsh. were also present on this site.

Foliage: Leaves lustrous, bluish green, glabrous, ovate or deltoid-ovate, long acuminate, doubly serrate with 39-48 serrations per side; base rounded, truncate or cuneate; blades on fertile branchlets 4-7 cm. long, 2-4 cm. wide; petioles 2-3 cm. long.

Twigs: Glabrous, even on young seedlings; except for a scattering of glands in some specimens.

Female Ament: Cylindrical, 2.5-3 cm. long, 0.8-1 cm. in diameter.

Male Ament: 1, 2 or 3 in a cluster.

Fertile Bract: Lateral lobes diverging, longer than median lobe, which is less than one third length of whole bract; upper surface hispidulous; length 5-7 mm.

Samara: Achene, urn- or spindle-shaped, glabrous except for a few fine hairs at apex; length 3-3.5 mm., width 1-1.2 mm.; styles 1.25-1.4 mm.; wing wider than achene.

Bark: Creamy-white, freely exfoliating.

Most specimens examined have white, pinkish, or cream-colored bark which is separable in layers.. Specimens with brown bark occur on Brier Island where *B. papyrifera* and *B. cordifolia* also have bark of this color, and from Grand Manan Island, N.B. The main variation is in the shape of the basal portion of the leaves which, though usually cuneate, may be rounded, truncate or even subcordate on the same tree. Though leaf margins ordinarily have a proportion of double serrations, one specimen (No. 7A) had leaves which were predominantly singly serrated, but in other respects, agreed with the typical specimens. No. 7V5 also presented minor differences, as shown in Figure 1. In regard to leaf color it was noted that a bluish tinge was by no means universal and even seedlings from the same tree show wide variation in this respect. However, when two adjacent populations of *B. papyrifera* and *B. caerulea-grandis* are examined a color distinction is discernible in that the *B. caerulea-grandis* population is a lighter green or blue-green color.

The first species to show signs of growth in spring is *B. papyrifera.* At that time there is no sign of life in *B. populifolia.* The growth habit of *B. cordifolia* and *B. caerulea-grandis* is intermediate between these two species. Pollen discharge follows a similar pattern which would allow cross-pollination to occur readily between *B. caerulea-grandis* and either *B. cordifolia* or *B. populifolia,* but more difficult in the case of *B. populifolia* and *B. papyrifera.*

B. *Betula caerulea* Blanchard

At the same time that Blanchard brought out his *B. caerulea-grandis* (1904a, b) he also proposed the name *B. caerulea* for a "small leaved, small seeded" white birch growing in the same neighbourhood. On one of his sheets Blanchard has appended a note as follows: "This species is very abundant south of Stratton Town House . . . *B. caerulea-grandis* occurs also but less plentiful. Some gray and paper birch also and some yellow birch". (The fact that he does not mention *B. cordifolia* is probably because he may not have distinguished it from the "white birch", *Betula papyrifera strictus sensu.*) This small-seeded, small-leaved, birch he describes as follows:

"*Betula caerulea* — Blue Birch. Tree small, larger than the gray birch. Bark separable into sheets. Leaves thin, long-pointed, somewhat cuneate at base, nearly regular in outline, glabrous on both sides, no tufts or tomentum usually. Petioles long slender. Strobiles cylindric 2.5 $\times$ 1.0 cm. Fruiting bracts very distinctive in shape".

Among the specimens of *B. caerulea* included in the Vermont herbarium and marked "typical" is one taken at "Carelton's lot", Windham, Vermont, August 1, 1903, which we have designated as the type specimen (our No. B-6). The following is a brief description:

Betula caerulea Blanchard (B-6)

Windham, Vermont, August 1, 1903 at Carelton's lot. Tree 10-16 meters in height, with white or pinkish exfoliating bark. Branchlets smooth or

glandular, especially on young growth, non-pubescent. Leaves glabrous, small, and sometimes extending into a long caudate tip; more finely serrate than *B. caerulea-grandis* with serrations per side 39-48 and 8 veins, light green or bluish green in color. Length of leaves on fertile shoots to 5.5 cm., width to 4.5 cm. Male ament 2-2.5 cm. long, 2 or 3 in a cluster. Female ament 2 cm. long. Bract with extending lateral lobes, 4.4 mm. long. Achene narrower than wing, glabrous except for tip, which may be slightly hispidulous, 1.5 mm. long, 1.2 mm. wide; styles 1 mm. long.

Blanchard himself (1904a, b) and Fernald (1922) emphasized the abundance of *B. populifolia* wherever *B. caerulea* occurred and considered *B. caerulea* to represent a cross of *B. papyrifera* with *B. populifolia.* Certainly, the general appearance of the two species supports this interpretation, though the chief difference as seen in our specimens is in the smaller, more finely serrate leaves and in the uniformly smaller size of seed and bracts together with a generally slower growth rate of the latter species. Crosses already initiated may be expected, however, to settle this problem.

Also included in Blanchard's Vermont collections and all marked "typical" *B. caerulea* are the following which agree with the specimen described above in all essential detail:

"Windham, Vermont. May 18, 1914, Aug. 1, 1903, Harrington Pasture, over half mile north of Village".

"Windham, Vermont, June 11, 1903, July 9, 1904. 10 rods south of St. Marie's house — one half mile north of Windham Village".

"Windham, Vermont. Roadside, June 11 and 20, 1904. One half mile north of Windham Village at old steam millsite of Mr. St. Marie".

Included with Blanchard's *caerulea* specimens in the Gray Herbarium, Harvard University are the following:

"White birches. Stratton, Vt. High ground 1,800 ft.; Blue Birch; small leaved, small fruited. Pretty thick bark. July 7, 1903 (Fig 2, B-17).

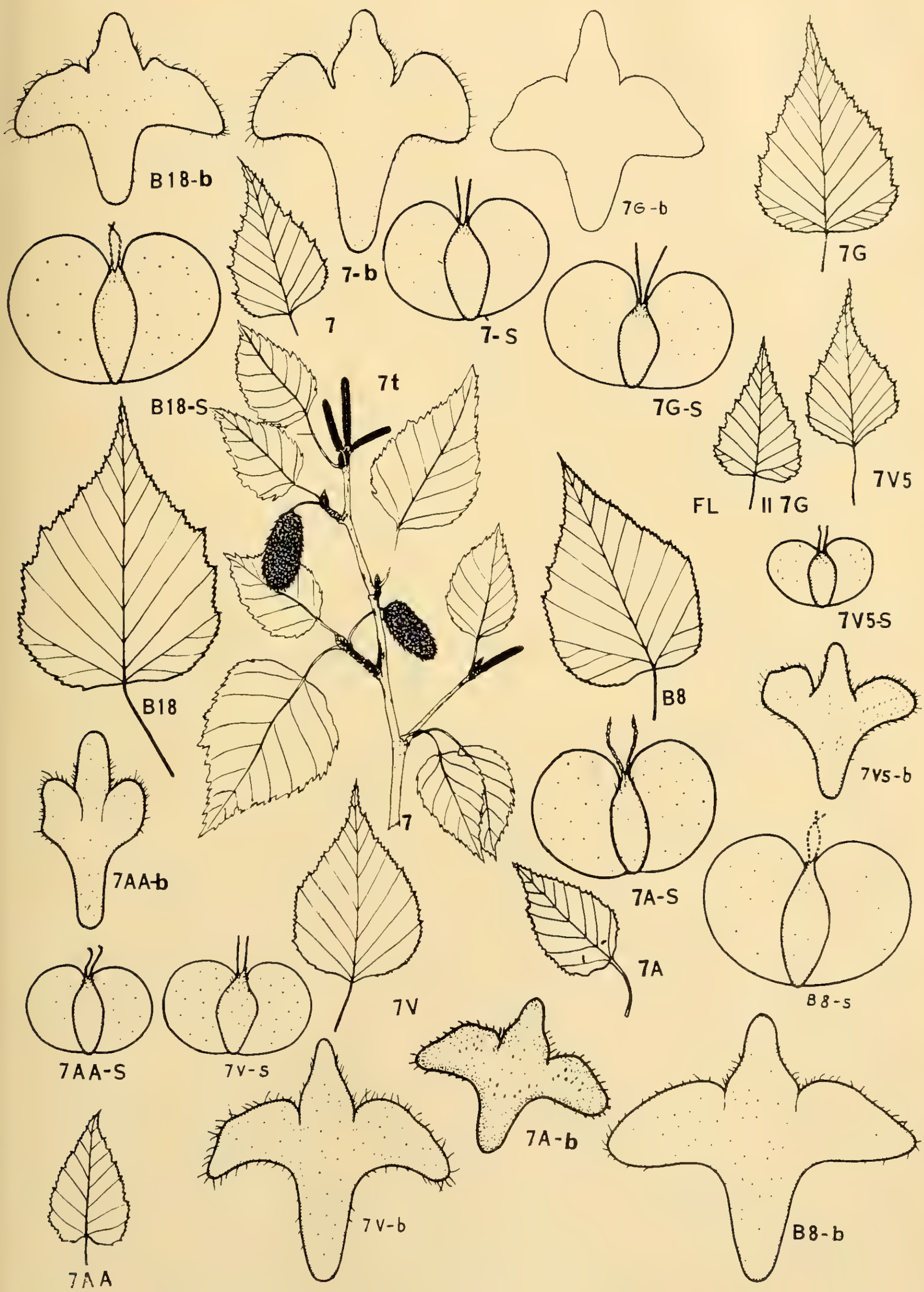
"Windham, Vt., Aug. 1, 1903. 1,600 ft. el. Slope of Glebe Mt. Like all the other blue birch. Small-leaved, small-fruited, abundant at this station". (Fig. 2, B-4).

The foregoing description of the lectotype specimen (Fig. 2, B-6) would apply almost exactly to one from Valcartier, P.Q. In fact the only notable difference is the form of the fertile bract (Fig. 2, No. 6).

C. *Hybrids:*

In our seedling collection, consisting of some hundreds of individuals, specimens of *B. caerulea-grandis* are larger, more strongly growing trees. One plant (No. 7G) was observed to have produced female catkins in 1964 in the

FIGURE 1. Representative illustrations of leaves and catkins (reduced ca. $\frac{1}{2}$), bracts and samaras ($\times$ ca. 4) of *B. caerulea-grandis.* b = bract, s = samara, FL = first year seedling leaf, t = twig. The numbers refer to accessions: 7, Charlottetown, P.E.I.; 7A, Killarney Lake, N.B.; 7AA, Arnold Arboretum, Massachusetts; 7G, Guysboro, N.S.; 7V and 7V5, Valcartier, P.Q.; B-8, Sherbrooke, P.Q.; B-18, Stratton, Vermont, $2n = 28$, except 7AA, $2n = 42$ and no living material of B-8 and B-18 (herbarium specimens).


B18-b
7-b
7G-b
7G
B18-S
7
7-S
7G-S
7t
FL
II 7G
7V5
B18
B8
7V5-S
7VS-b
7AA-b
7
7A-S
7A
B8-s
7AA-S
7V-S
7V
7A-b
7AA
7V-b
B8-b

absence of any pollen source of this species. However, *B. populifolia* is abundant in the Morgan Arboretum and seedlings grown from the seed of No. 7G are now under observation.

No hybrids of *B. caerulea-grandis* with *B. cordifolia* have been recorded, though G. C. Cunningham provided a specimen which he considered represented this particular cross and from this specimen seedlings with the appearance of intermediates are now growing in the Arboretum as will be discussed later. Cunningham in correspondence concerning this specimen stated: "*Betula caerulea-grandis* must have some of the same ecological requirements as *Betula cordifolia* and *Picea rubens* and is most easily found where these are found together". The situation has been somewhat confused by the fact that *B. cordifolia* has so commonly been lumped with *B. papyrifera* and the special characteristics of the former have not always been recognized. Therefore, before proceeding to a discussion of possible *B. cordifolia* hybrids, a comparison of its characters with *B. papyrifera* becomes necessary and is here presented in tabular form. Measurements are taken from our own collections only.

A comparison of *B. papyrifera* and *B. cordifolia* in Eastern Canada.

B. papyrifera Marsh.	*B. cordifolia Regel.*
1. First leaves of seedling densely pubescent along veins on underside.	1. First leaves smaller, darker, more finely pubescent and with "ribbed" appearance due to stronger veins.
2. Stem of young seedlings densely pubescent obscuring lenticels.	2. Seedling stem more finely pubescent, with lenticels plainly visible and often ringed with flecks of cuticle, which remain adhering to the stem for some time.
3. Outline of leaf variable, elliptic ovate to oblong or even broadly lanceolate. Leaf-base shape also variable, cuneate, rounded, truncate, more rarely subcordate. Tip acuminate, to long acuminate. Marginal serrations 20-50 per side, with mean of 32.	3. Leaves cordate or mostly so, with widest point approximately 1/3 distance from base. Marginal serrations 30-80, mean 44.
4. Branchlets smooth; new growth pubescent.	4. Branchlets smooth.
5. Female catkin, average length 3.9 cms.	5. Female catkin, average length 5 cms.
6. Bract of pistillate catkin 5.6 mm. long on the average, variable in form, with lateral lobes porrect, extending or, less often, reflexed, usually angular; medium lobes tapering.	6. Bract with an average length of 8 mm., lateral lobes ascending in smooth curves and with finger-like medium lobe having parallel sides extending well beyond the lateral lobes; tip rounded.
7. Achene densely hispidulous on upper half; average length 2.17 mm., width 1.45 mm., styles 1.45 mm.	7. Achene less densely hispidulous; the area of hispidulation mostly confined to upper third, with individual hairs coarser and more widely spaced. Average length 2.75 mm., width 2 mm., styles 2.27 mm.
8. Growth of seedlings, at least in early years, more rapid than in *cordifolia*. Counts of 100 seedlings show an average growth of 3.01 m. in 5 years.	8. Growth of seedlings slower in early years; average 5 years, 1.02 m.
9. Chromosome number: $2n = 56, 70, 84$.	9. Chromosome number $2n = 28$. A few tetraploid specimens (allotetraploids?, see text) with $2n = 56$ have been found.

Represented in our seedling plantings, is our No. 163, from Frizzleton, Inverness Co., N.S., collected by G. C. Cunningham and O. L. Louckes, and considered to represent an intermediate condition between *B. caerulea-grandis* and *B. cordifolia.*

> Leaves ovate, with cuneate, rarely subcordate base, and long acuminate tips, finely and doubly serrate with leaves on fertile shoots having 45-64 serrations per side, dark green, lighter below; length of 7 cm. Fertile bract to 8 mm. and resembling that of *B. cordifolia*, but with relatively shorter medium lobe. Achene 2 mm. long and 1.3 mm. wide, but with the comparatively long styles characteristic of *B. cordifolia of* 1.75 mm. long; hispidulous for one-third length.

Seedlings from this tree are identical in growth rate and growth characteristics to *B. cordifolia* growing in the same area. Still another specimen (No. 173) from West Quaco, N.B., also displayed intermediate characteristics, but from this specimen, no seedlings were available. A number of other individuals, some of which possess characters close to *B. cordifolia* and others more nearly akin to *B. populifolia*, were collected in the summer of 1966. A preliminary examination of these specimens reveals no clear dividing line between *B. caerulea* and *B. caerulea-grandis.* Further study is in progress to obtain quantitative data to resolve this point.

The Valcartier site presents a number of puzzling forms of which two (No. 391 and 392) are of particular interest. They were found growing in close proximity and both had been tentatively identified as *B. caerulea-grandis*, differing mainly in the long styles of No. 392 and the somewhat more numerous subcordate leaves of that specimen. Both resembled the "large fruited, large leaved white birch" as described by Blanchard for *B. caerulea-grandis*; both have the somatic chromosome number of 28 which has been determined for this species. However, with the first leaves, a startling difference became evident. The young leaves and stem of No. 391 were very characteristic of *B. cordifolia.* Those of No. 392 had the long tip and lighter color of *B. caerulea-grandis.* It is difficult to escape the conclusion that No. 391 contains an element of *B. cordifolia* although it is quite different in appearance from No. 163. On the other hand, No. 392 is not the "small seeded, small fruited" white birch as illustrated by numbers 6 and B-6. Both are now in their second year of growth and their future development will be followed with close attention. In the meantime a detailed description of No. 391 is herein recorded:

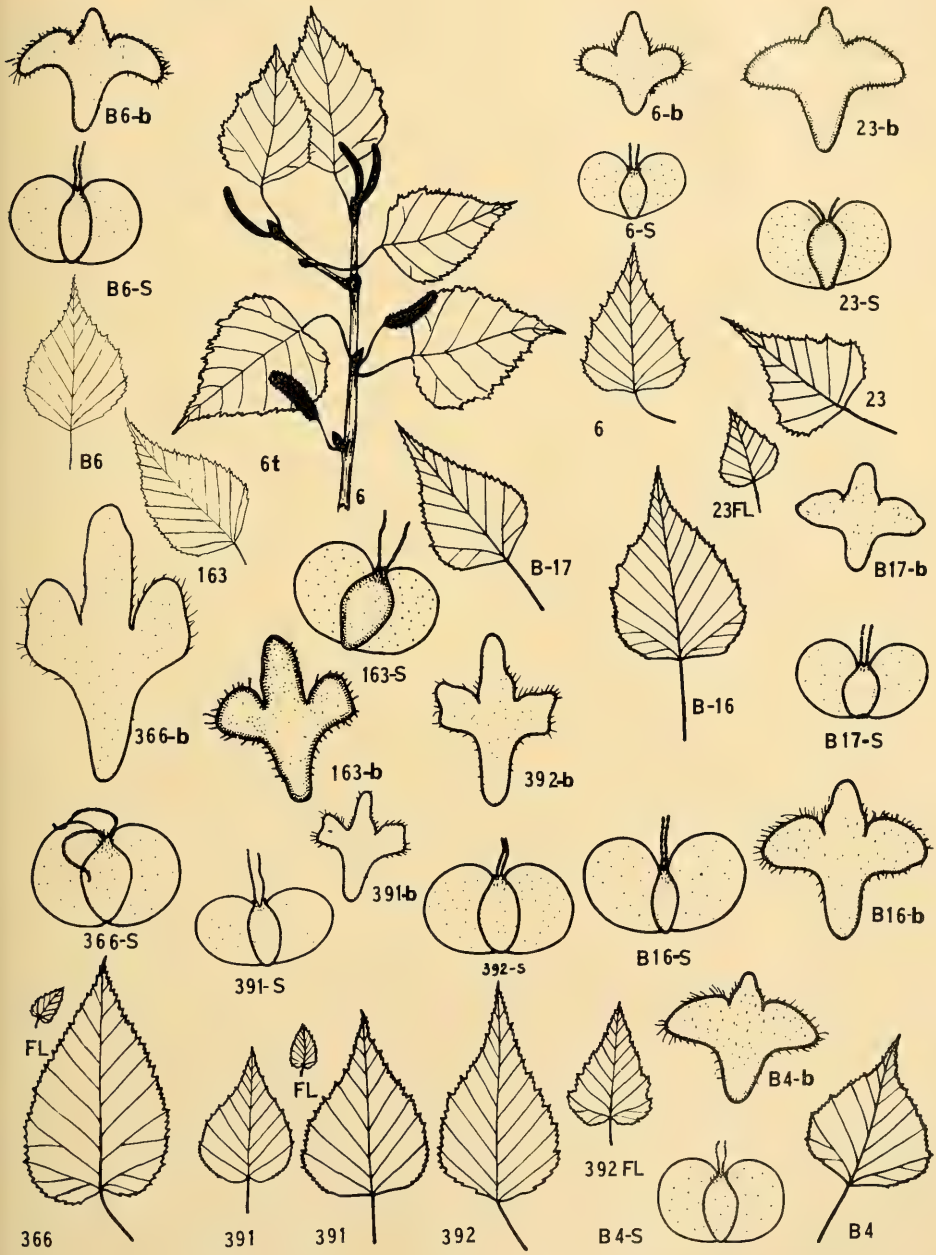
> Tree up to 20 meters in height and 8 cm. diameter at breast height with white, or whitish, bark exfoliating in thin layers. Branchlets smooth. Winter buds ovate, acute, brownish, scales with some marginal hairs, 6 mm. long. Leaves broad ovate with long acuminate tip, truncate, subcordate or shallow cuneate at base; margin coarsely and irregularly doubly serrate, average serrations on side, 44; dull green above, lighter below; 6-7.5 mm. long, on fertile shoots 3-4.5 cm. with axils of veins

mostly non-pubescent below. Petioles stout, 20 mm. in length. Male aments mostly in clusters of three. Female aments pendulous 3-3.5 cm. long, 0.7-1.0 cm. wide. Bracts puberulous with lateral lobes extending horizontally, rounded, median lobe narrowing to apex but with rounded tip 9.5-10 mm. long. Fruit a samara with achene much narrower than wing, sparsely hispidulous at apex; achene 2.4-2.6 mm. long, 1.3-1.5 mm. wide and styles 1.7-2.5 mm. long. Bark white, exfoliating. Chromosome number $2n = 28$. Agreeing with the foregoing specimens in essential details is No. 65 ($2n = 28$).

Finally of very special interest is our number 7AA (Arnold Arboretum No. 5251) grown from seed originally given to the Arnold Arboretum by Blanchard. This specimen, however, bears little resemblance to the "typical" specimens supplied by him to the Gray Herbarium or to his own specimens in the herbarium at the University of Vermont. We can only assume that he forwarded seed from a "typical" tree, which had been cross pollinated by some other species. Considerable difficulty was encountered in rearing seedlings, from seed of this tree (No. 7AA) and only two survived from a sowing of some hundreds of seed, though most other collections when mature germinated 80 per cent or over. As other students have studied the tree at the Arnold Arboretum in the belief that it was the true *B. caerulea-grandis*, the following description will be of interest.

Tree with creamy-white, exfoliating bark and very smooth slender branchlets. Leaves strongly and uniformly cordate as in *B. cordifolia*, but smaller and relatively narrower, measuring on fertile shoots, up to 4.5 cm. long and up to 2.03 cm. wide, pubescent in axils of veins and along petiole on under side, with some marginal hairs and with at least 8 veins and 50-55 serrations on each side. Male aments mostly in clusters of three. Female aments pendulous, length 3-3.5 cm., width to 1 cm. The fruit represents an intermediate condition between *B. cordifolia* and *B. caerulea-grandis*. The bract most closely resembles *B. cordifolia* though more slender, having ascending non-angular lateral lobes, with median lobe with parallel margins, as in that species. The samara, however, more closely resembles that of *B. caerulea-grandis* but smaller. The achene is mostly glaborous but with a few hairs at the apex; length 2.3-2.7 mm., width 1 mm. and styles 1.7-1.75 mm. Wing wider than achene. Chromosome number $2n = 42$.

FIGURE 2. Representative illustrations of leaves and catkins, bracts and samaras of *B. caerulea-grandis*, except numbers 23 (*B. populifolia*) and 366 (*B. cordifolia*). Magnification as in figure 1. b = bract, s = samara, FL = first year seedling leaf, t = twig. The numbers refer to accessions: 6, 391, 392, Valcartier, P.Q.; B-6, Windham, Vermont; B-16, Windham, Vermont; B-4, B-17, Stratton, Vermont; 163, Frizzleton, N.S.; 23, Morgan Arboretum, P.Q.; 366, Northwest River, Labrador. Acc. Nos. 6, 23, 163, 391, and 392, $2n = 28$. Acc. Nos. 163, 391 and 392 are hybrids between *B. caerulea-grandis* and *B. cordifolia*.


B6-b
6-b
23-b
B6-S
6-S
23-S
B6
6t
6
6
23
23FL
163
B-17
B17-b
163-S
B-16
366-b
163-b
392-b
B17-S
391-b
B16-b
366-S
391-S
392-S
B16-S
FL
FL
B4-b
392 FL
366
391
391
392
B4-S
B4

The characteristics of this specimen clearly indicate that it contains an element of *B. cordifolia*. The most probable explanation for this hybrid would be that Blanchard's parent tree (*B. caerulea-grandis*, $2n = 28$) had been pollinated by a tetraploid *B. cordifolia* ($2n = 56$) of which a few specimens with *cordifolia* characteristics and a tetraploid chromosome number have been observed (Brittain and Grant, 1965b), thus producing the triploid specimen that now stands in the Arnold Arboretum ($2n = 42$). We are not convinced, however, that our tetraploid *B. cordifolia* are pure *cordifolia* and there is the possibility that these are progeny from a cross of *B. papyrifera* ($2n = 84$) $\times$ *B. cordifolia* ($2n = 28$). The triploid Arnold Arboretum specimen ($2n = 42$), therefore, may be the result of a trihybridization with the latter two species and *B. caerulea-grandis* ($2n = 28$), that is, (*B. papyrifera* $\times$ *B. cordifolia*) $\times$ *B. caerulea-grandis*. The Morgan Arboretum at Macdonald College now contains both seedlings and grafts from the tree at the Arnold Arboretum and these will be observed further.

Our specimen No. 89 obtained from the Arnold Arboretum No. 5250-A and labelled *B. caerulea* is clearly not co-specific with Blanchard's specimens labelled "typical". On the other hand it appears to have close affinities with *B. papyrifera* in fruiting characters, though with a suggestion of *B. caerulea-grandis* in the form of the leaves which, however, show a much greater amount of pubescence on the underside than ever found in *B. caerulea-grandis*. The somatic chromosome number of this plant is 70 which would suggest that it is a hybrid.

Several authorities have suggested that *B. papyrifera* is involved in the *B. caerulea—B. caerulea-grandis* complex (Erskine, 1960; Fernald, 1922; Sargent, 1922) but we have found no evidence to support this view and the somatic chromosome number of all specimens of *B. caerulea-grandis* and *B. populifolia*, including putative hybrids, is $2n = 28$ which would not be expected in crosses with *B. papyrifera*. Moreover, seedlings produced by artificial crosses between *B. papyrifera* and *B. populifolia* while still immature, do not closely resemble seedlings of *B. caerulea-grandis*. On the other hand, the synchronous blossoming period and the common chromosome number of *B. cordifolia* suggests the desirability of considering the relationship of this species to the problem.

SUMMARY

A morphological and cytological study has been carried out on hybrids which are reported for the first time between *Betula caerulea-grandis* Blanch. and *B. cordifolia* Regel. Morphological characteristics of the parental species and hybrids and seedling growth characteristics have been given to differentiate the species and hybrids from *B. papyrifera* and *B. populifolia* growing in the same area. A somatic chromosome number of 28 has been determined for four of the five hybrids between *B. caerulea-grandis* and *B. cordifolia*. The one exception is a triploid hybrid ($2n = 42$) which may be the result of

pollination between a tetraploid *B. cordifolia* ($2n = 56$) with *B. caerulea-grandis* ($2n = 28$), or possibly a trihybrid from a cross of [*B. papyrifera* ($2n = 84$) $\times$ *B. cordifolia* ($2n = 28$)] $\times$ *B. caerulea-grandis* ($2n = 28$).

ACKNOWLEDGEMENTS

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REFERENCES

BLANCHARD, W. H. 1904a. New white birches. Betula 1(1): 1.

————. 1904b. A new white birch. Betula 1(2): 1-2.

BRITTAIN, W. H. and GRANT, W. F. 1965a. Observations on Canadian birch (*Betula*) collections at the Morgan Arboretum. I. *B. papyrifera* in eastern Canada. Canadian Field-Naturalist 79: 189-197.

————. 1965b. Observations on Canadian birch (*Betula*) collections at the Morgan Arboretum. II. *B. papyrifera* var. *cordifolia*. Canadian Field-Naturalist 79: 253-257.

ERSKINE, D. S. 1960. Betulaceae, p. 128-131. *In* The Plants of Prince Edward Island, Canada Department of Agriculture Publ. No. 1088.

FERNALD, M. L. 1922. Notes on the flora of western Nova Scotia. Rhodora 24: 171-173.

SARGENT, C. S. 1922. Manual of the trees of North America. Vol. 1. Houghton Mifflin Co., New York. (Reprinted, 1961. Dover Publications Inc., New York).

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TWIN SEEDLINGS AND ABNORMAL GERMINATION IN THE YELLOW BIRCH, *BETULA ALLEGHANIENSIS* BRITTON*

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INTRODUCTION

MULTIPLE seedlings were first discovered in oranges by Leeuwenhoek in 1719. Since then, occasional cases of polyembryony have been recorded among the seeds plants and this feature has been usefully employed for plant improvement by plant breeders as well as by the horticulturists (Maheshwari and Sachar 1963). Polyembryony is a common feature among the gymnosperms, particularly in the Coniferales. In conifers several embryos may be initiated but usually only one matures; the rest abort. However, in angiosperms the occurrence of a single egg cell per embryo sac in an ovule results in a single embryo per seed. Rarely, a partial "twin" has been recorded (Maini 1960). In *Betula alleghaniensis* Britt. (yellow birch) the gynoecium is bicarpellary, syncarpous, unilocular, with only one ovule maturing into a seed in the mature fruit (a nutlet or small samara). For convenience this nutlet bearing a single seed is referred to as a "seed" in this report. The normal germination in this species is epigeal, where emergence of the radicle from the distal (micropylar) end of the seed is followed by that of the cotyledons.

During our investigations on the germination behaviour of *B. alleghaniensis*, 10,000 seeds were placed on moist filter paper in petri dishes maintained at about 72°F (23°C). Out of these, we encountered emergence of twin seedlings from 12 seeds. In another four seedlings, the cotyledons emerged from the pericarp before the radicle. These cotyledons either emerged from the dorsal side of the seeds or from the micropylar end. Each of the two abnormalities is described separately below.

TWIN SEEDLINGS

The first sign of twin seedlings was marked by the emergence of two radicles from the distal (micropylar) end of a seed (Figure 1A). In most cases the growth rate of the two radicles was similar, while in others one grew slightly faster than the other. Usually the two plumules did not shed the

*According to Little (1953) and Brayshaw (1966), the correct name for the yellow birch is *Betula alleghaniensis* Britton, and the well-known and widely-used name *B. lutea* Michx. must be rejected because the latter is a superfluous name which is inadmissible according to Articles 62 and 63 of the International Code of Botanical Nomenclature (Lanjouw, 1961).

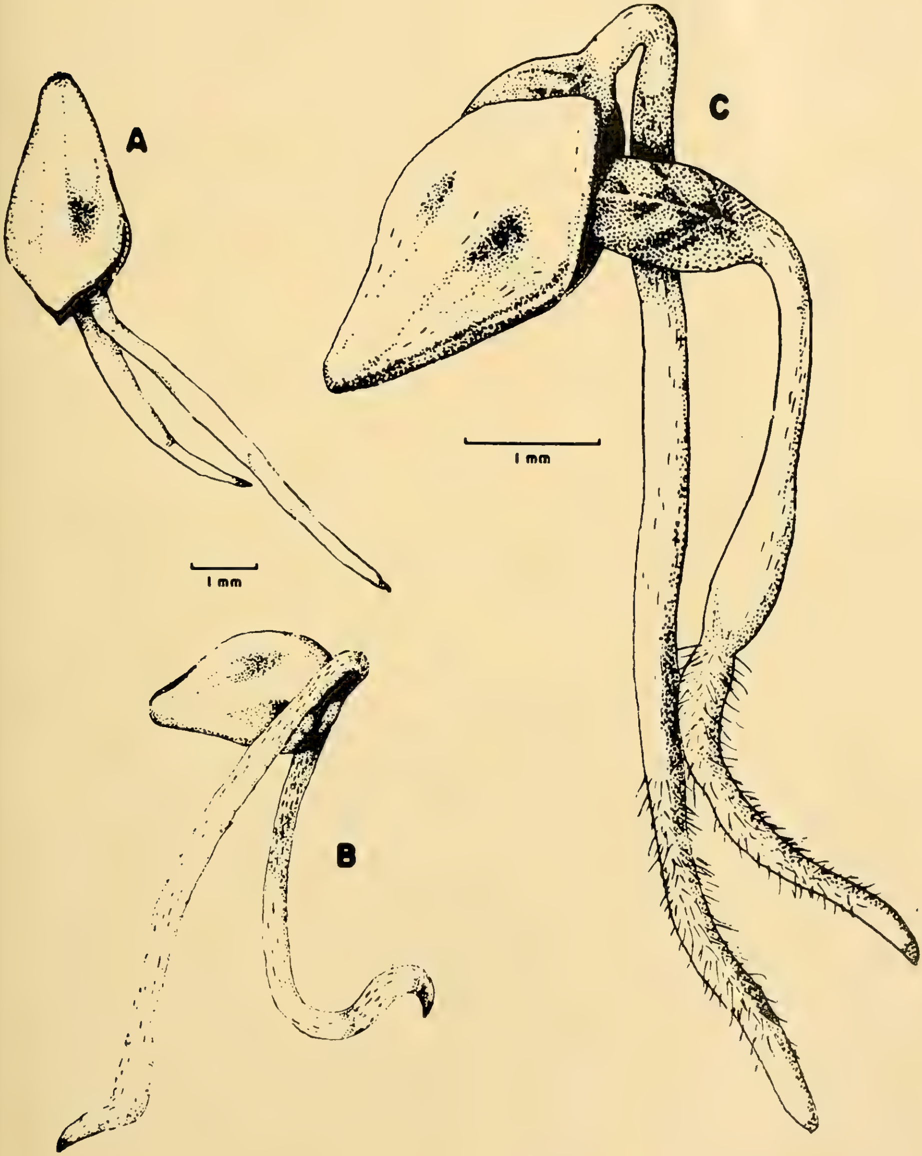


FIGURE 1. Emergence and initial development of twin seedlings of *Betula alleghaniensis.*

"seed coat" (pericarp) simultaneously but one emerged earlier than the other (Figure 1B-C). The position of the seedlings indicated that the two embryos were arranged parallel to each other; this feature was further confirmed by dissection of two seeds with twin seedlings at a very early stage of germination. Morphologically the twin seedlings were similar to the normal seedlings.

Polyembryony has attracted considerable attention during recent years (Webber 1940, Maheshwari 1950, Maheshwari and Sachar 1963). According to Maheshwari and Sachar (1963), polyembryony is of two types, false and true. When accessory embryos arise within a *single* embryo sac (either by the complete cleavage of the zygote, or, from the fertilized or unfertilized synergids and rarely from the antipodal cells) the resultant polyembryonic condition is termed as true. However, development of *two or more* embryo sacs within the same nucellus, or, fusion of two or more nucelli, may result in false polyembryony. True polyembryony also includes adventive embryos which arise from tissues outside the embryo sac and ultimately come to lie within the embryo sac. When the incidence of plural embryos is very low, it is difficult to study their origin by developmental study of the embryogeny. The parallel positioning of twin embryos observed in *Betula alleghaniensis* suggests that this condition probably arose by a complete cleavage of zygotic embryo. However, a cytological analysis of *B. alleghaniensis* twin seedlings was not made to confirm this suggestion. A similar positioning of genetically identical twin embryos of *Zea mays* was recorded by Randolph (1936) and attributed to cleavage of zygotic embryo.

During recent years, the considerable economic potential of polyembryony in plant improvement has been recognized. Indeed polyembryony has been employed successfully in some agricultural and horticultural plants. It has been artificially induced by manipulating temperature, use of X-rayed and foreign pollen and treatment of ovules by various chemicals and hormones (Wardlaw 1955, Maheshwari and Sachar 1963). According to Maheshwari and Sachar (1963) twin embryos normally show the following combinations: diploid-diploid, haploid-diploid, diploid-triploid and haploid-triploid. While haploids may be utilized to produce homozygous diploids, adventive embryos may be very valuable in producing genetically uniform seedlings. In the seed population studied by us, the frequency (0.12 per cent) of seeds with twin embryos was appreciable. Occurrence of twin seedlings in *B. alleghaniensis* needs further investigation and may hold useful possibilities in breeding programmes for this commercially valuable forest tree species.

PRE-EMERGENCE OF COTYLEDONS

Betula alleghaniensis seeds normally germinate by emergence of the radicle from the micropylar end and a simultaneous rupturing of the pericarp. The rupture is along the suture that is formed by the coalescence of the two carpels (Figure 2). The radicle is positively geotropic and eventually becomes

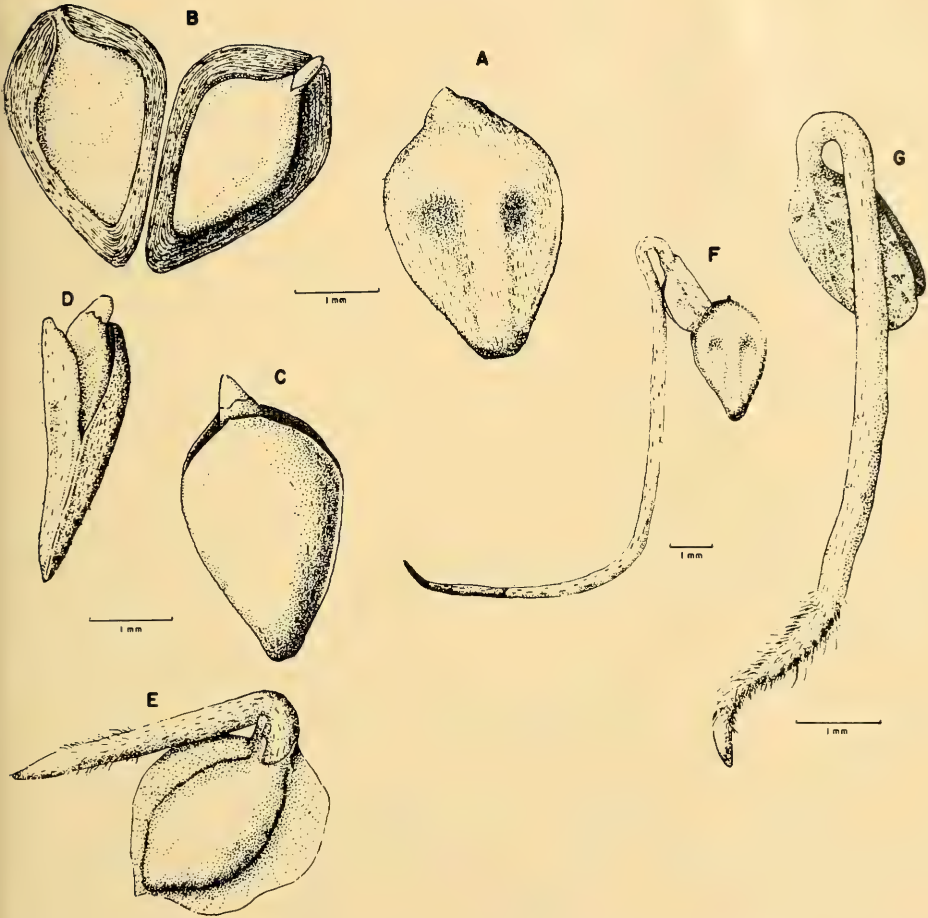
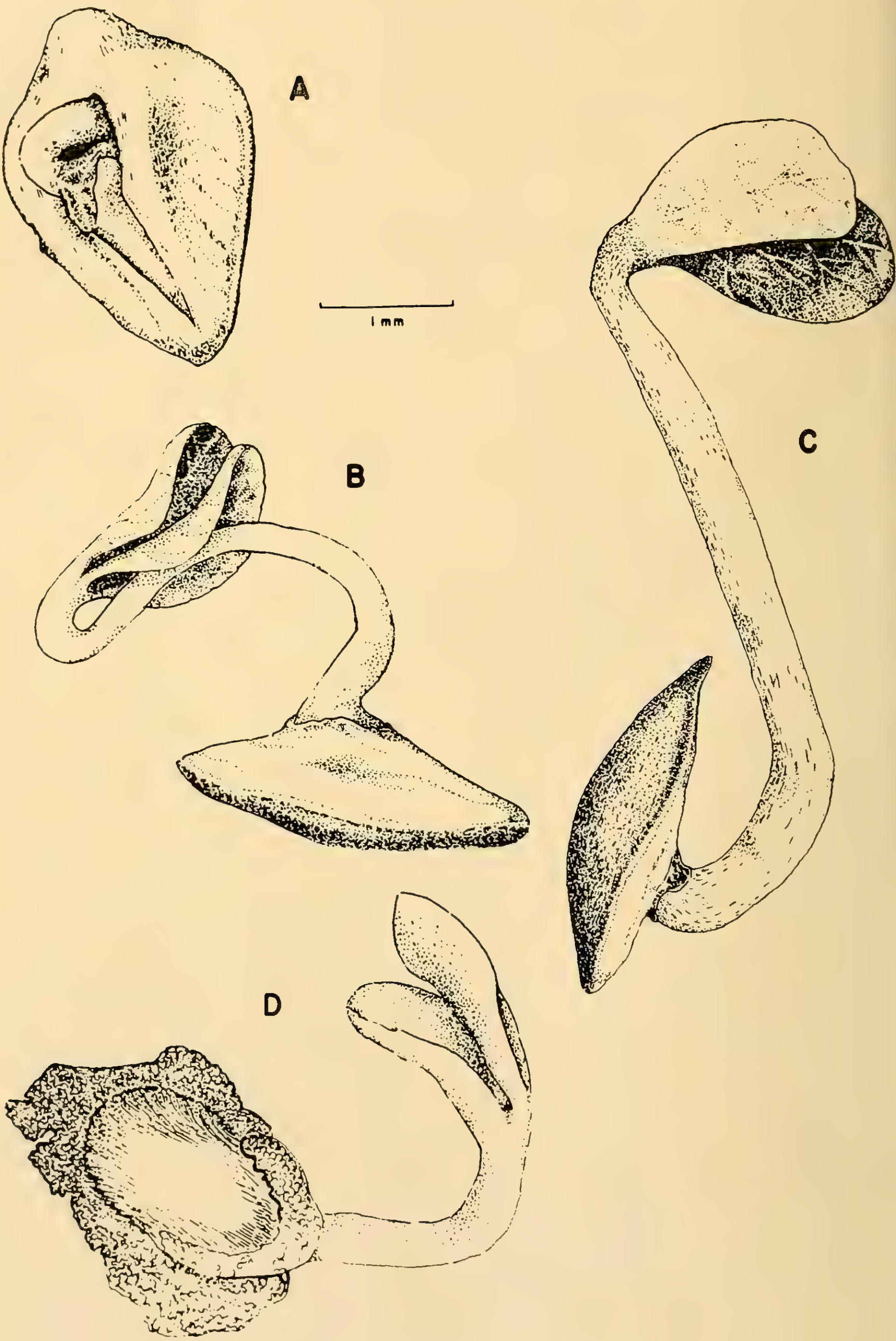


FIGURE 2. Various stages in the normal germination of *Betula alleghaniensis* seeds. A — dorsal view of a seed; B — a seed dissected open along the suture showing normal positioning of the radicle; C — ventral view of a seed showing emergence of radicles from micropylar end; D — side view of seed showing splitting of the pericarp along the sutures; E, F and G — elongation of radicle and subsequent shedding of the pericarp.

anchored in the soil; subsequently, the hypocotyl elongates and raises the cotyledons above the forest floor. The cotyledons soon separate and become approximately horizontal.

In three seedlings, we observed the emergence of cotyledons from the dorsal side of the seed where the pericarp had burst (Figure 3A). After the emergence of the plumule, the hypocotyl elongated considerably (Figure 3B-C),


A
1 mm
B
C
D

but the radicle did not emerge from the pericarp and, after four to six days, the seedlings started to degenerate.

It is not possible to determine the cause of this unusual type of seed germination. Non-emergence of the radicle suggests (i) a possible existence of mechanical obstruction towards the micropylar end; (ii) after soaking the seeds in water, the swelling of cotyledons and elongating radicle did not exert sufficient pressure to rupture the pericap along the sutures; (iii) in the de-winging process, mechanical damage to the pericarp could also result in a similar pattern of germination. According to Baldwin (1942), such abnormalities may be attributed to excessive moisture in the seedbed where "swelling may progress at a faster rate than the mobilization of enzymes within the seed and force the seed coat open before the plantlet is ready to emerge".

At the micropylar end of one seed, the cotyledons emerged first instead of the radicle (Figure 3D) and the seedling died after 8 days. This was obviously a case of disturbed polarity of embryo which in normal cases is determined during early post-fertilization stages.

Food supply of such seedlings is seriously affected owing to lack of contact between roots and soil. Such seedlings do not become autotrophic and consequently degenerate. This type of unusual germination was observed very rarely in our experiments and appears to be of little consequence in natural regeneration of the species.

SUMMARY

In a population of 10,000 seeds of *Betula alleghaniensis* Britt. under investigation, the frequency of occurrence of twin embryos was 0.12 per cent. Occurrence of twin seedlings was attributed to a cleavage of zygotic embryo. This feature may have valuable possibilities in a breeding programme of this commercially valuable species. In another four seeds, the first sign of germination was emergence of cotyledons instead of radicle and the cotyledon emergence was either through a rupture at the dorsal surface of the seeds or through the micropylar end.

ACKNOWLEDGEMENTS

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FIGURE 3. Abnormal germination of *Betula alleghaniensis* seed, showing emergence of cotyledons through a rupture on the dorsal surface (A-C) and through micropylar end (D).

REFERENCES

BALDWIN, H. I. 1942. Forest tree seed of the north temperate regions. Chronica Botanica Co., Waltham, U.S.A. 240 p.

BRAYSHAW, T. C. 1966. The names of yellow birch and two of its varieties. Canadian Field-Naturalist 80: 160-161.

LANJOUW, J., editor. 1961. International code of botanical nomenclature. International Association for Plant Taxonomy. Utrecht, Netherlands.

LITTLE, E. J., JR. 1953. Check list of native and naturalized trees of the United States including Alaska. U.S. Forest Service. Agriculture Handbook No. 41. Washington. 472 p.

MAHESHWARI, P. 1950. An introduction to embryology of the angiosperms. McGraw-Hill, New York. 453 p.

MAHESHWARI, P. and R. G. SACHAR. 1963. Polyembryony. p. 265-296. *In* P. Maheshwari (Editor). Recent advances in the embryology of angiosperms. International Society of Plant Morphologists, University of Delhi, India. 467 p.

MAINI, J. S. 1960. Invasion of grassland by *Populus tremuloides* in the Northern Great Plains. Unpublished Ph.D. Thesis, University of Saskatchewan, Saskatoon, Canada. 231 p.

RANDLPH, L. F. 1936. Developmental morphology of the caryopsis in maize. Journal of Agricultural Research 53: 881-916.

WARDLAW, C. W. 1955. Embryogenesis in plants. Methuen & Co. Ltd., London. 381 p.

WEBBER, J. M. 1940. Polyembryony. Botanical Review 6: 575-598.

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FEMALE SEXUAL CYCLES OF *CHRYSEMYS PICTA* AND *CLEMMYS INSCULPTA* IN NOVA SCOTIA[1]

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THE female sexual cycle has been studied in several species of emydid turtles (*Chrysemys picta*: Cagle, 1954; *Pseudemys scripta*: Cagle, 1950; and *Terrepene ornata*: Legler, 1960). In each species, not all large ovarian follicles are used in the production of a complete clutch of eggs, and the authors suggested that the remaining large follicles would form second or even third clutches to be deposited later in the same season.

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Latitudinal variation in clutch size is a well-known phenomenon in many animal groups, including turtles (Carr, 1952 for *Chrysemys picta belli* and *Chelydra serpentina*, and Tinkle, 1961 for *Sternothaerus odoratus*). It has been suggested that the larger clutches of northern turtles may represent the entire complement of large follicles, thus compensating for the presumed fewer number of clutches laid by them. Tinkle's (1961) data do not support this view, but are not entirely relevant to the problem as neither northern nor southern populations of *Sternothaerus* showed evidence of multiple clutches.

As part of a general study of turtles in Nova Scotia, data on these aspects of turtle reproduction have been gathered for the Painted Turtle, *Chrysemys picta*, and the Wood Turtle, *Clemmys insculpta*, and are presented below.

METHODS

The author has examined the female reproductive tracts of 72 mature *Chrysemys* and 14 mature *Clemmys*, all from Nova Scotia, the north-east extremity of the ranges of both species. Of the *Chrysemys*, 47 were collected in 1964, 2 in 1962, and 23 in 1961; inspection of the data does not indicate any yearly differences. All *Clemmys* females were collected in 1964.

Specimens were classified as belonging to one of four generally discrete populations, termed as follows: (1) Oxford: the area within a five mile radius of Oxford, Cumberland County; (2) Shubenacadie: the area between Elmsdale, Hants County; Meaghers Grant, Halifax County, and Shubenacadie; (3) Kings: Sunken Lake and the lower Gaspereau and Cornwallis River valleys in Kings County; and (4) Queens: Lake Kejimkujik, Queens and Annapolis Counties. Two specimens from Bridgetown, Annapolis County are not included in this classification.

The follicles of left and right ovaries were measured and recorded separately, all follicles larger than 3/16″ diameter being assigned to appropriate size classes by means of a plastic gauge containing a series of holes graduated in size. The size classes are as follows: Class 4, 3/16″-4/16″; Class 5, 4/16″-5/16″; . . . Class 11, 10/16″-11/16″. Follicles intermediate in size were assigned to the lower size class. Follicles in classes 8 to 11 were termed "large" on an empirical basis. Oviducal eggs were counted. All measurements are from preserved material. The exact date of capture of three specimens of *Chrysemys* is not known, and consequently they were included in some calculations (e.g. clutch size) but not in others.

OVARIAN CYCLE OF CHRYSEMYS

Chrysemys in Nova Scotia exhibits the general emydid pattern (Table 1). The growth of new follicles is first evident in August, during which time virtually all measured follicles were in classes 4 to 7. In specimens from August 31 and September 1, the plurality of measured follicles was in classes 6 and 7, whereas specimens from September 7-8 show a plurality in class 8. Specimens from May 19-26 (pre-ovulation) have most measured follicles in classes 8 to 11, the plurality occurring in class 10. This class represents the size (5/8″) at

TABLE 1.—Size classes and number of follicles, and number of oviducal eggs, in Nova Scotian *Chrysem*

Date	Area*	No. of Follicles								No. of Eggs	Date	Area*	No. of Follicles								No. o Eggs
		Size Classes 4	5	6	7	8	9	10	11				Size Classes 4	5	6	7	8	9	10	11	
5 19 61	K	1	–	2	1	2	7	5	4	–	7 13 61	Q	–	–	–	–	–	2	3	–	–
5 25 61	K	4	–	–	–	4	6	7	1	–	7 13 61	Q	1	–	1	–	–	4	–	–	–
5 26 61	K	4	2	–	–	4	4	6	5	–	7 13 61	Q	1	1	–	–	3	7	–	–	–
5 26 61	K	2	–	1	3	4	1	12	–	–	7 ? 62	Q	2	2	–	–	–	–	–	–	5
5 29 64	S	4	2	1	1	3	1	–	–	10	7 ? 62	Q	4	2	1	–	–	–	–	–	–
5 30 64	S	–	3	1	3	3	3	–	–	9	7 23 64	S	–	1	–	–	4	–	–	–	6
5 30 64	S	1	4	2	3	3	3	–	–	9	7 31 64	Q	1	–	–	–	–	–	–	–	–
5 30 64	S	2	–	1	3	6	–	–	–	8	7 31 64	Q	3	2	–	1	4	1	–	–	–
6 1 61	K	1	1	1	3	3	5	1	–	9	7 31 64	Q	7	1	–	–	5	–	–	–	–
6 1 61	K	–	3	–	1	5	1	–	–	7	7 31 64	Q	–	–	2	2	–	–	–	–	–
6 1 61	K	–	1	2	1	1	4	1	–	10	7 31 64	Q	3	1	3	2	–	–	–	–	–
6 1 61	K	3	1	1	3	–	4	2	–	9	8 1 64	Q	4	1	2	1	1	–	–	–	–
6 2 61	K	5	1	1	–	2	6	1	–	11	8 22 64	A	1	2	3	9	–	–	–	–	–
6 2 61	K	–	–	1	–	1	8	–	–	7	8 22 64	A	7	3	10	–	–	–		–	–
6 5 61	K	–	1	–	1	1	5	–	–	10	8 28 64	S	4	3	8	4	–	–	–	–	–
6 9 64	K	3	1	–	–	2	3	–	–	10	8 30 64	S	5	3	9	1	3	3	–	–	–
6 13 64	K	–	2	1	1	3	4	4	2	–	8 30 64	S	9	5	10	–	–	–	–	–	–
6 21 61	Q	–	–	–	–	–	1	–	–	7	8 30 64	S	7	3	3	6	2	–	–	–	–
6 21 61	Q	2	2	–	1	2	6	2	–	6	8 31 64	S	7	6	8	5	–	–	–	–	–
6 22 64	O	–	–	1	–	1	6	–	–	10	8 31 64	S	1	2	11	7	3	–	–	–	–
6 27 64	O	–	2	–	2	2	1	1	–	7	8 31 64	S	3	4	8	15	–	–	–	–	–
6 27 64	O	–	–	–	1	–	–	–	–	11	8 31 64	S	3	12	9	6	–	–	–	–	–
6 27 64	O	3	4	–	–	5	6	–	–	9	9 1 64	S	1	8	3	6	–	–	–	–	–
6 2? 61	Q	–	1	–	–	–	4	2	–	9	9 1 64	S	–	1	9	7	–	–	–	–	–
7 1 64	S	–	1	2	2	3	4	–	–	–	9 1 64	S	1	6	2	7	2	–	–	–	–
7 2 64	S	1	2	1	3	5	5	–	–	–	9 1 64	S	4	8	5	4	5	–	–	–	–
7 2 64	S	1	–	1	2	–	–	–	–	9	9 1 64	S	3	5	5	8	3	–	–	–	–
7 2 64	S	4	–	–	1	3	2	–	–	8	9 7 64	O	7	3	5	1	12	–	–	–	–
7 2 64	S	1	–	3	1	–	2	3	1	–	9 7 64	O	3	3	3	4	4	6	–	–	–
7 2 64	S	–	–	–	–	5	–	–	–	11	9 7 64	O	2	6	3	4	9	–	–	–	–
7 5 61	Q	1	2	3	–	–	–	–	–	–	9 8 64	O	2	–	11	12	5	4	–	–	–
7 7 61	Q	1	2	–	1	4	4	–	–	–	9 8 64	O	2	6	2	2	9	–	–	–	–
7 11 61	Q	1	–	–	–	–	3	4	–	–	9 8 64	O	2	4	3	6	2	–	–	–	–
7 11 61	Q	–	–	–	2	–	–	1	–	–	9 8 64	O	9	7	1	7	2	–	–	–	–
7 11 61	Q	–	1	–	–	–	1	–	–	7	9 8 64	O	2	4	5	3	8	4	–	–	–
7 11 61	Q	–	2	–	2	2	3	1	–	–	9 8 64	O	4	12	2	9	1	–	–	–	–

*A = Bridgetown; K = Kings; O = Oxford; Q = Queens; S = Shubenacadie.

which follicles usually rupture. It is felt that this increase in size up to classes 10 and 11 occurs during the autumn, and that turtles emerging in the spring are fully ready to ovulate.

Ovulation occurs near the end of May. Of 20 females caught between May 28 and July 1 all but one contained oviducal eggs. (This single specimen, collected on June 13, had 13 large follicles and no perceivable corpora lutea.) Thus oviducal eggs are retained for at least four to five weeks. By comparison, Legler (1960) states that *Terrepene ornata* in Kansas retains eggs for two to three weeks. It is not known whether longer retention periods in northern turtles is a general phenomenon, and if so, whether eggs so retained develops more quickly than eggs in a nest for the corresponding period of time.

Females with oviducal eggs were found up to July 23, giving a minimal nesting period of three weeks for the population as a whole. Only four specimens were examined for second sets of corpora lutea, and second set was found on only one of these, an ovigerous female collected on June 21. Corpora lutea apparently diminish rapidly in size after oviposition, making detection of second sets extremely difficult. The two females with oviducal eggs found after July 10 had small clutches (6 and 7 eggs) and relatively few large follicles (4 and 1), suggesting that they may have oviposited earlier in the season.

Ovigerous females from June average 6.2 large follicles whereas those from July average only 2.5. Statistically this difference is highly significant ($P < .01$). By August, large follicles have mainly disappeared, and presumably represent, in some cases, second clutches. The reappearance of follicles in classes 8 and 9 during late August and September is due to the growth of smaller ones.

If large follicles are not ovulated, they must be absorbed or become atretic. It is difficult to account for their loss by reabsorption, for the reabsorption of large ova would have to occur simultaneously with the growth of smaller ones. Atretic follicles were uncommon, and in the several cases in which they were noted, they were not large follicles but medium-sized ones.

OVARIAN CYCLE OF CLEMMYS

Although the number of mature female *Clemmys* is not large enough to permit description of the sexual cycle, the specimens do show clearly that *Clemmys insculpta* in Nova Scotia does not have the typical emydid pattern; it differs conspicuously in the relative uniformity of follicular growth and ovulation (Table 2).

The single specimen from September shows a distinct group of ten large follicles, which represent one complete clutch. The corresponding follicles in *Chrysemys* are massed together with smaller follicles, and when they do form a distinct group the next spring, the group is sufficiently large to represent two complete clutches.

The two earliest collected specimens, from June 5, each contained oviducal eggs. In the same general area, on June 21, concentrated nesting activity was observed, and two completed nests were found. From these data it is estimated that in *Clemmys* eggs are retained for a minimal period of three weeks.

Only one clutch is laid per season, as is indicated from the data from the ovigerous specimens. Virtually all large follicles are ovulated in the single clutch; of the twelve ovigerous females, eight are without large follicles and the remaining four have only one each.

Although a specimen with oviducal eggs was found as late as July 15, field observations indicate that, in the vicinity of Oxford at least, the nesting season is very short (about a week) and is earlier than for *Chrysemys*, by perhaps a week also.

CLUTCH SIZE OF CLEMMYS

The known clutch size of *Clemmys* in Nova Scotia ranges from 4 to 11, having a mean of 8.2 and a distinct mode of 8 to 10 (Table 3). This is based on: 12 counts of oviducal eggs, 1 count of corpora lutea, 3 nest counts, 2 counts of nests of hatchlings, and single specimens described by Bleakney (1952) and F. R. Cook (personal communication). Clutch size has been stated by Pope (1939) to range from 7 to 12, and by Carr (1952), from 4 to 12. These data essentially the same as those for Nova Scotia. However Babcock (1938) cites the clutch size of New England populations as ranging from 4 to 7. As none of these authors gives details or references it is impossible to determine whether Nova Scotian *Clemmys* do or do not produce larger clutches than more southern populations.

TABLE 2.—Size classes and number of follicles, and number of oviducal eggs, in Nova Scotian *Clemmys*

Date	Area*	No. of Follicles Size Classes 4	5	6	7	8	9	10	11	No. of Eggs
6 5 64	O	8	1	–	–	–	–	–	–	9
6 5 64	O	1	1	1	–	–	1	–	–	9
6 20 64	O	3	6	2	–	–	–	–	–	5
6 21 64	O	8	6	2	–	–		–	–	8
6 21 64	O	5	6	–	–	–	–	–	–	10
6 21 64	O	5	6	–	–	–	–	1	–	8
6 21 64	O	9	7	1	–	–	1	–	–	9
6 21 64	O	8	3	–	–	–	–	–	–	8
6 22 64	O	2	3	5	1	1	–	–	–	4
6 23 64	O	11	1	–	–	–	–	–	–	7
6 26 64	O	3	3	–	–	–	–	–	–	9
6 26 64	O	5	11	–	–	–	–	–	–	–
7 15 64	S	9	–	–	–	–	–	–	–	9
9 1 64	S	2	2	2	–	–	4	6	–	–

*O = Oxford; S = Shubenacadie.

CLUTCH SIZE OF CHRYSEMYS

The clutch size of *Chrysemys* in Nova Scotia, based on 25 counts of oviducal eggs and one nest count, ranges from 5 to 11, with a mean of 8.5 and a mode of 9 (Table 3). This is considerably larger than clutch sizes reported for *C. p. picta* and *C. p. marginata*, both ancestral to the Nova Scotia population (Bleakney 1958a). Carr (1952) gives the "most usual" clutch size for *picta* as 5 to 6, with a range of 3 to 11; for *marginata* he gives the same range, and the "usual" complement as being 5 to 8. Cagle (1954) gives the following data for the species: southern Illinois, mean 6.3, range 3-8, N = 48; Tennessee, 4.3, 3-6, N = 13; and northern Michigan, 4.7, 2-7, N = 12.

TABLE 3.—Percentage distributions of clutch sizes of Nova Scotian *Clemmys* and *Chrysemys*

Species	N	Clutch Size							
		4	5	6	7	8	9	10	11
Clemmys	20	5	10	–	10	25	25	20	5
Chrysemys	26	–	4	12	19	8	27	19	12

It appears that even within Nova Scotia more northern populations lay larger clutches. Averages for the three northern populations are: Oxford, 9.2 ($N = 4$); Shubenacadie, 8.8 ($N = 8$); and Kings, 9.1 ($N = 8$). Analysis of variance indicates that none varies significantly. Southwestern Nova Scotia is so climatically propitious that the area supports relict populations of two reptiles, *Emydoidea blandinoi* and *Thamnophis sauritus* (Bleakney 1958b). In *Chrysemys* from this area (Queens) the mean clutch size is 6.7 ($N = 6$); the difference between this and the mean clutch size for the rest of the province combined is highly significant ($P < .01$).

SUMMARY AND CONCLUSIONS

In both *Chrysemys* and *Clemmys* in Nova Scotia, mature females produce clutches yearly. Some *Chrysemys* may lay two clutches per year. *Clemmys*, in producing only enough large follicles for one complete clutch, shows much closer regulation of large follicle production than does *Chrysemys* or other emydid species for which data are available.

In *Chrysemys*, more northern populations do lay larger clutches, and this tendancy is evident even within the province. However, comparison of data from Nova Scotia with those published for more southern populations does not indicate that more clutches are produced in the southern populations to compensate for their smaller egg complements. It is unknown whether more southerly populations of *Clemmys* produce smaller clutches.

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REFERENCES

BABCOCK, H. L. 1938. Field Guide to New England Turtles. New England Museum of Natural History, Natural History Guide No. 2.

BLEAKNEY, J. S. 1952. The Amphibians and Reptiles of Nova Scotia. The Canadian Field-Naturalist 66(5):125-129.

———. 1958a. Postglacial Dispersion of the Turtle *Chrysemys picta*. Herpetologica 14:101-104.

———. 1958b. A Zoogeographic Study of the Amphibians and Reptiles of Eastern Canada. National Museum of Canada Bulletin 155:1-119.

CAGLE, F. R. 1950. The Life History of the Slider Turtle, *Pseudemys scripta troostii* (Holbrook). Ecological Monographs 20 (1):32-54.

———. 1954. Observations on the Life Cycles of the Painted Turtles. American Midland Naturalist 52(1):225-235.

CARR, A. 1952. Handbook of Turtles. Cornell University Press.

LEGLER, J. M. 1960. Natural History of the Ornate Box Turtle, *Terrepene ornata ornata* Agassiz. University of Kansas Publications 11(10):527-669.

POPE, C. L. 1939. Turtles of the United States and Canada, Knopf, New York.

TINKLE, D. F. 1961. Geographic Variation in Reproduction, Size, Sex Ratio and Maturity of *Sternothaerus odoratus* (Testudinata: Chelydridae). Ecology 42(1): 68-76.

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REVIEWS

The Birds of Canada

By W. Earl Godfrey. The National Museum of Canada, Ottawa. 1966. 428 pp. 69 color plates, 71 line drawings and 382 two-color maps. $12.50.

More than a generation has passed since Taverner's classic work presented a summary of the birds of Canada. Although there have been several comprehensive publications covering the individual provinces this is the first time since 1934 that current knowledge of the distribution and occurrence of all Canadian birds have been assembled in a single volume.

Regional works are always exciting and there is no diversion I enjoy more than to lie on my back for hours studying the range maps, the species accounts and the ilustrator's interpretations of familiar and not-so-familiar species. Ever since receiving this long-awaited book with its stunning photograph of an Arctic Tern on the jacket I have been indulging in an ornithological binge.

Up to January 1, 1964, the date chosen by W. Earl Godfrey as his cutoff date, 518 species of birds have been recorded in Canada. Another 20 species are on the hypothetical list, mostly sight records, unsupported by specimens or indisputable photographic evidence.

Canada, washed by 3 oceans has had more than its share of accidental sea birds —waifs from afar. Such unlikely birds as Yellow-nosed Albatross, Brown Booby, and the magnificent Frigatebird have been brought to Canadian shores by sea storms. So have visitors from the Old World—Little Egret, Barnacle Goose, Eurasian Crane, European Coot, European Golden Plover, European Woodcock, Lapwing, and others. Indeed, in view of the recent discovery of Little Gulls nesting in Ontario it is no longer too far-fetched to expect other Palearctic birds to colonize eventually. The European Widgeon, Black-headed Gull and Ruff are the most likely candidates for colonization in view of their increasing occurrence on this side of the ocean. No doubt Jim Baillie will be the first to find them.

Birds from the southern United States —such unlikely species as the Caracara, Chuck-wills-widow and Bachman's Sparrow have reached Canada. The most strategic spots seem to be Point Pelee on Lake Erie for wind-drifted migrants from the interior, and the southern tip of Nova Scotia (and also Newfoundland) for hurricane waifs. It is difficult, however, to explain the Virginia Warbler, a bird of the southwestern United States, that was collected at Point Pelee or the Yellow-green Vireo, a Mexican species, that turned up at Godbout, Quebec. William Gunn would probably have an answer.

The informative text of *The Birds of Canada* is a nice combination of the museum man's point of view and that of the field observer. Godfrey's reputation, of course, is based on his skill as a taxonomist and museum curator. He points out key technical characters and has supplemented them with 71 line drawings by S. D. MacDonald. These illuminate such details as the comparative bill structures of Horned and Eared grebes, axillars of the two widgeon and mantle-feathers of juvenal loons—details that are conclusive when a specimen comes to hand.

However, field recognition demands a different approach, and obviously the author knows his birds equally well in life. Under each species there is a critically distilled paragraph, *Field Marks,* which is backed up by John A. Crosby's handsome color plates.

As a bird illustrator, I am always intrigued by the methods and skills of my contemporaries. Like myself and most

other North American bird artists, Mr. Crosby has been strongly influenced by the Fuertes tradition. This is a sound tradition that has been embraced by many faunistic publications where the purpose has been twofold: (1) to summarize the known status and distribution of birds; and (2) to interest and inform the public. It is for the second reason (and especially for the new audience-) that such books are often so lavishly illustrated. The working biologist (and there are relatively few) would settle for the basic facts and may complain that the pictures are mere window dressing adding to the cost. Such a view, sometimes expressed by academics, betrays a naive understanding of the realities of publishing. In fact, the funds for publication would seldom be forthcoming if the public interest were to be ignored.

Every bird illustrator strives or should strive to leave the stamp of his own inventiveness on his portraits. If he has the rare opportunity of painting individual portraits or compositions–one species per page–he has no problem. He can let his imagination soar. But the straightjacket of portraying on the same plate half a dozen species or more, many of which would never be seen together, has led to a sameness in some books of this type. The illustrator, using the space economically, spots a bird here, another one there, on an equal-area basis, perhaps vignetting a bit to take care of the inconsistencies of environment. The result is often quite static.

Aware of this, Crosby developed a new wrinkle of his own. He introduced an inset, a scenic panel involving only one species–a solid block placed judiciously on the white page to act as counterpoint to small portraits of several related species without background. I find this an attractive idea, one that gives the book a different look. However, at some point Mr. Crosby must have tired of this formula, for he abandoned it, going back to the more traditional assemblages. Indeed, in a few plates (as in the Icterids, etc.) he has come very close to the schematic presentation of the field guides. I wish he had retained his original formula throughout the book, but it is just possible that it would not have worked out too well for the passerines.

I was told that toward the end of his assignment (and doing such a series is like a stretch in jail) Mr. Crosby felt so dissatisfied with some of his earlier things that he did them over. This dissatisfaction of the artist is inevitable. On every job I have done, my work became far more facile toward the end of the ordeal. Certainly Mr. Crosby's talents have developed considerably during the course of his long task, and he must now be ranked with Terry Shortt and Fenwick Lansdowne as one of the three most competent Canadian bird portraitists. His shore-birds are superb, as fine as any I have seen. The plate of the swifts and goatsuckers is especially competent in handling difficult subject matter and some of his warbler plates are gems. The color-reproduction is excellent.

Maps are the most vulnerable thing in a regional work, as I well know from my own experience in helping prepare them for the European Field Guide. There is always someone, somewhere, who has a bit of unpublished information that modifies the literature on which such maps are based. Nonetheless, clean, clear maps are one of the most useful contributions of any regional work. This is certainly true of Earl Godfrey's splendid *Birds of Canada*.

In reviewing such maps some critics may wonder whether all of Newfoundland and Nova Scotia should have been blocked in for the Arctic Tern rather than just the coast lines; and whether the whole southern end of Ontario should have been shaded red for the Prothonotary Warbler when but 4 or 5 definite breeding localities are known. Small maps, of course, dictate such oversimplification. On large, full page maps, the

compiler can use the spot method which indicates only actual documented breeding records. On the other hand, such detailed maps, although more precise in their way, may often give distorted impressions; for example, because of the greater number of observers, a species may appear to enjoy greater numbers near a large center of population. On the other hand, it may seem to be scarce or even absent in a more remote or unworked area. This is often quite contrary to the facts. However, if there is any question of interpretation of Godfrey's maps the reader need only turn to the paragraph, *Range in Canada,* for clarification. The ranges of subspecies are not indicated on the maps (they are often clinical anyway) and are handled in capsule statements at the ends of the species accounts.

This new book will give a tremendous stimulus to field birding in Canada. The maps are there for all to see and an army of competitive binocular-toters will take delight in extending ranges and in spotting rarities. The more serious students will monitor the trends, the spread or the decline of species, and this book, as of the year 1964, will be their benchmark.

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Natural Areas as Research Facilities

Report of the American Association for the Advancement of Science Council Study Committee on Natural Areas as Research Facilities. 1963. American Association for the Advancement of Science, Washington, D.C. Paperbound. 8½ x 11. $3.75 (US). 295 pp.

This volume sets out the findings and recommendations of a special committee to the AAAS Council and deals almost entirely with the United States. The basic task of the committee was "to determine just how important natural areas were as research facilities, and on the basis of this to find out how adequate the existing natural areas are, what the need for additional areas is, and what to do about it."

Natural areas are defined as "areas where, at least at present, natural processes are allowed to predominate, not significantly influenced by deliberate manipulation or accidental interference (to any great extent) by man." The committee did not consider it to be of value to spend time considering areas that do not have some form of legal protection since with present trends in land and water utilization, areas which seem natural today may be bulldozed, polluted or otherwise changed tomorrow.

The first 80 pages contain the report of the committee. This is followed by four appendices. Appendix A (193 pages) gives a bibliography of 2400 research papers based wholly or in part on natural areas. This list, admittedly very incomplete, provides a guide to the kinds of contributions natural areas have made to scientific knowledge.

Appendix B (39 pages) gives a tentative inventory of natural areas in the United States, together with the type of area, ownership and acreage. Appendix C (32 pages) is the Proceedings of the First National Symposium on College Natural Areas sponsored by the Nature Conservancy (US) and entitled *College Natural Areas as Research and Teaching Facilities.* Appendix D (31 pages) gives miscellaneous documents mostly pertaining to natural area policies of Federal Agencies holding public lands in the United States.

Perhaps the most important recommendation of the committee is that there is need for a formal system of natural scientific areas within the public domain. The committee believed that this could be accomplished through an inter-agency agreement by those agencies that have responsibilities for the public lands. The

direct administration, protective and research activities would be the responsibility of the individual agency which holds such lands, but an integrated system would lessen duplication and lend added security to the preservation of these scientifically important sites.

Another important recommendation is that colleges, universities, and research institutions likely to be concerned with outdoor research of any kind make every effort to acquire and legally insure the preservation of examples of all significant natural ecosystems occurring within easy reach of their headquarters and that are not already available in accessible protected natural areas.

Appendix C – College Natural Areas as Research and Teaching Facilities, deserves special comment because of the importance and growth of universities today. This symposium should be useful to university administrations and to those departments planning to acquire natural areas for the use of their staff and students. Part I, which deals with "The role of Natural Areas in Education and Research", includes three contributed papers. Part 2 includes a paper on "Planning for Acquisition and Use". The symposium includes a list of college natural areas in the United States, with details as to acreage, type of area and so on.

This volume will be of importance to many persons in Canada, a country in which many (even biologists) simply assume that wild areas of all types are "inexhaustible." The problems of research in Canada are very similar to those existing in the United States and this report will provide a good perspective of what is in store for us as our population continues increasing.

Although the volume deals mainly with the United States a number of pages of discussion are devoted to other countries. It is pointed out that the situation in Latin America and, indeed, in the tropics generally, is critical. Relatively little is known about tropical floras, faunas, and ecology, in comparison to temperate areas, and the rate of destruction of tropical ecosystems with their phenomenally rich assemblages of species, is alarming. Unquestionably, thousands of tropical species now living will become extinct before they are ever even collected, let alone studied. A plea is made to the affluent countries to take some action to try to preserve at least some of these richly endowed tropical environments now destined for certain destruction. These efforts could presumably be tied to already existing foreign aid programs or they could be made by an enlightened or a concerned scientific community.

Natural areas have, of course, uses other than as research facilities but the committee was not instructed to look into these. Such areas, if carefully selected, may serve as educational and training facilities but perhaps most important of all the areas often provide a last refuge and a home for thousands of species of living things that stand a very small chance of surviving in more direct competition with man. If we accept the tenet that forms of life other than man (including forms which today are of little or no use to man) have a right to life, then we are obliged to ensure that adequate environments are preserved for them.

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The Whooping Crane

By FAITH MCNULTY. Clarke, Irwin and Company Limited, Toronto and Vancouver. 1966. 190 pp. Illustrated. $5.95.

This book, winner of the Dutton Animal Book Award for 1966, will appeal to

the very many who have followed the long and much-publicized struggle of the Whooping Crane for survival. It is highly profitable reading for the majority of us whose knowledge of the events in that greatest conservation classic is derived mainly from scraps of information that appear in the papers from time to time. The author has assembled the facts from numerous scattered sources, documented them well, placed them in their proper sequence and perspective, and made the whole into a thrilling and authentic story.

Mrs. McNulty has had access to sources of information, including official files, not used heretofore by writers on the subject, and her quotations from them provide fascinating and illuminating reading. With delightful objectivity she names the various individuals and organizations who have influenced the course of events concerning the Whooping Crane and she frankly sets forth the facts regardless of whether the individuals concerned had motives that were good, bad, or indifferent.

The book pays high tribute to the majestic Whooping Crane whose serious plight is that it is trapped in an environment that no longer has room for it and perhaps is unwilling to make room. It is also a tribute to dedicated and hard-working conservationists, notably the late Robert P. Allen who did more than any other one person to aid effectively this distressed bird. The true story it tells has aspects of diplomacy, hard work, greed, indifference, dedication, frustration, and limited success. The reader, having finished the book, will certainly know a lot more about the Whooping Crane and about the biggest bird conservation story of our day. He will also know a lot more about his fellow men!

W. EARL GODFREY

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John James Audubon, A Biography

By ALEXANDER B. ADAMS. G. P. Putnam's, New York. Longmans Canada Limited, 55 Barber Greene Road, Don Mills, Ontario. 1966. 510 pp. Illustrated. $10.00.

This latest biography of John James Audubon, colorful painter of birds and self-styled American woodsman, is in many ways the best. Alexander Adams has done a vast amount of research on Audubon's life. He has succeeded in presenting a clearer picture of many aspects of Audubon than has been done heretofore, and his presentation is lucid, interesting, and authoritative.

Throughout the book, Audubon is treated as a man, not an idol. His weaknesses are not glossed over and his strengths are not minimized. However, perhaps his early life, during which he was sometimes foolish, is treated in greater detail than his later years of success and outstanding achievement. The overall result is that Audubon's shortcomings are more frequently spotlighted than in other biographies. Audubon's occasional deviations from the truth, and the pranks he played on his eccentric colleague, Rafinesque, are not amusing. For instance, his fake drawings depicting non-existent fishes misled Rafinesque into publishing names and descriptions of them as taxa new to science. Ironically, Rafinesque's honest acknowledgment in print of Audubon as the authority for these fakes is an eternal monument to the latter's immaturity.

The book is filled with glimpses of the life and color of the times and these make absorbing reading: old New York, Pittsburgh, New Orleans, Henderson, Louisville, Natchez; steamboats, riverboats, and stagecoaches.

Apparently the author is more of an authority on ornithologists than on ornithology. Contrary to him, the Golden Plover is not particularly long-legged, the Least Bittern is not a shorebird, and the bird depicted in a painting used to illustrate Audubon's early work

is not a Whip-poor-will but a Nighthawk.

The book closes with an imposing bibliography and an equally impressive chapter on information sources. They indicate to some extent the prodigious amount of work that went into the preparation of the manuscript. The book is well made and well printed. This reviewer enjoyed it from cover to cover and learned a great deal about Audubon that he didn't know before.

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A Guide to Field Identification, Birds of North America

By CHANDLER S. ROBBINS, BERTEL BRUNN, and HERBERT S. ZIM. Illustrated by ARTHUR SINGER. Golden Press, New York. 1966. 340 pp. Profusely illustrated in color. $3.95.

North American bird students have for some years been fortunate in having such excellent field guides as those by Peterson and by Pough to help them in the quick recognition of birds. Now comes this new field guide which offers some innovations and certain particular advantages of its own.

Instead of using two or three volumes, the new guide treats all the birds likely to be seen in North America north of Mexico under one cover. Only accidentals are excluded. Through more than 300 pages each right-hand page is devoted to good-quality color plates illustrating several bird species and painted by the talented artist Arthur Singer. On each facing (left-hand) page there is a succinct text for the species pictured. This gives, briefly, useful field recognition marks and habitat preferences, and contains small range maps showing the general breeding and winter distributions as well as isochronal lines to indicate the timing of spring migrations. Despite their small scale, the maps are quite useful although a few (Winter Wren, Brewer's Blackbird, Clay-colored Sparrow, Tennessee Warbler, Henslow's Sparrow, LeConte's Sparrow, and Swamp Sparrow) do not show quite all the breeding range in Canada. Vocalizations are presented by means of sonograms but how successful this particular feature will be remains to be seen.

The profuse color illustrations are well painted and usually well reproduced (even the small white areas near the base of the Parasitic Jaeger's bill are shown). In general, the adult male in breeding plumage is depicted, but in the many cases where the females or immatures differ markedly from the male, or where seasonal differences are important, these also are illustrated. For the larger and medium-sized species that are often seen on the wing, flight patterns are shown.

Points on the recognition of families and other groups are given briefly, the descriptions being augmented by silhouettes which are compared with silhouettes of representatives of similar looking groups.

There is a 12-page introduction containing much useful information. Throughout the book every bit of available space has been put to use.

Because of the large number of species included, the treatment of the individual species is not so full as in Peterson or Pough. However, the points presented are well chosen. The salient merits of this new guide are its vast geographic scope(it is useful from coast to coast in North America), its more numerous and generally excellent illustrations, the advantageous position of the text beside each species illustration, and its modest price. Its flexible plastic cover is adaptable to various pocket sizes and shapes.

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NOTES

Range Extension of Willets in Eastern Canada

On June 22, 1966 George Johnstone of Sackville showed me the nest of a Willet (*Catoptrophorus semipalmatus*) near his summer cottage at Baie Verte, New Brunswick. An adult bird flew from the nest, which was hidden among grass on top of a low sand beach separating a small salt marsh from the tide-flat. Two boys, Paul Johnstone and Allan Pooley, had found the nest on June 10 or 11, and on June 24 Mr. Johnstone obtained motion pictures of the three newly-hatched young. The fourth egg did not hatch and was later collected. This is apparently the first record of Willets breeding in the Province of New Brunswick (*cf.* W. A. Squires, 1952 *The Birds of New Brunswick*, New Brunswick Museum), as well as the first nest of the species to be found on the shores of Northumberland Strait.

Willets were once nearly extirpated in eastern North America. In 1920 their range in the Maritimes was restricted to Digby and Yarmouth Countries in extreme southwestern Nova Scotia (*cf.* R. W. Tufts, 1962 *The Birds of Nova Scotia*, Nova Scotia Museum), but they have spread greatly since that time. Tufts (*op. cit.*) considered the Willet to be of casual occurrence away from the Bay of Fundy and Atlantic shores of Nova Scotia, the extreme limits of assumed breeding being the estuary of Gaspereau River in Kings County and Isle Madame in Richmond County. The following spring and summer records, from my unpublished field notes unless otherwise credited, indicate that Willets have been present and probably breeding on Northumberland Strait since before 1960 (*see also* W. J. Mills, 1964, Canadian Field-Naturalist 78:62-63, for records on Prince Edward Island), and that their range there and on Cape Breton Island is still increasing.

(a) Locations where birds have been seen regularly, exhibiting behaviour characteristic of breeding birds:

Wallace Bay, Cumberland County—
- 1960: 12 May (8);
- 1963: 15 May (3);
- 1966: 27 May (4).

Waugh Island, near Malagash, Cumberland County—
- 1960: 12 May (10), 15 July (3), 5 August (1);
- 1961: 29 May (6), 16 July (3);
- 1962: 5 June (1);
- 1963: 13 May (9), 24 May (4), 9 June (4), 18 July (6).

Framboise Cove, Richmond County—
- 1951: 6 August (H. R. Webster, in W. E. Godfrey 1958, Canadian Field-Naturalist, 72: 7-27);
- 1960: 24 June (4), 30 June (3);
- 1963: 8 June (2);
- 1966: 28 May (3).

Big Glace Bay Lake Bird Sanctuary, Cape Breton County—
- 1960: 24 June (2);
- 1963: 8 June (4), 5 August (12, including flying young);
- 1966: 7 June (nest — 4 eggs; F. Alward, *in litt.*). 30 July (30, including flying young; F. Alward, *in litt.*).

(b) Location where observations suggested colonization was in progress:

Antigonish Landing, Antigonish County
- 1960: No observations during four visits in May to August;

1961: 29 June (5), birds ranging widely over marsh in group, calling occasionally, never diving at observer. Not seen on four other visits in May to August.

1962: 5 June (1), bird calling occasionally, not obviously on territory;

1963: 28 May (1),
29 May (1),
27 June (1), in same spot each time;

1965: 29 May (2), apparently paired on territory.

(c) Locations where birds were observed beyond suspected range, with suitable habitat near by:

Jersey Cove, Victoria County—

1963: 30 May (3),

1966: 29 May (1), birds silent, wary, on both occasions.

Mackay Point, near Judique North, Inverness County—

1961: 28 June (2); birds silent, wary.

Indian Point, near Port Elgin, Westmorland County, N.B.—

1965: 10 July (1), bird flying past, about two miles west of then unsuspected 1966 nest site.

The Willets that colonized the shores of Northumberland Strait probably came from the Bay of Fundy. Their range was expanding in this direction, as known breeding areas in Kings County, Nova Scotia, were first settled in the 1950's. Furthermore, the fact that Willets were apparently established in Cumberland County before they appeared at Antigonish and Judique to the east, and at Baie Verte to the west, argues against a spread there from the Atlantic coast via the Strait of Canso. The Framboise Cove, Glace Bay, and Jersey Cove records suggest continued range expansion along the southeast shores of Nova Scotia.

In closing, I will place on record an observation of a Willet on the shore of the St. Lawrence River near Ste. Flavie, Quebec, on June 18, 1955. This individual had the silent, wary behaviour characteristic of a non-breeding bird. At the time I assumed it to be a bird of the eastern race that had overshot its breeding range. Subsequently I learned that virtually all Willet specimens collected in Ontario belong to the western race (J. L. Baillie, *pers. comm.*), so allocation of this stray individual is clearly open to speculation.

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Accepted November 14, 1966

Rufous Hummingbird in Ontario

UNTIL now the common Ruby-throated Hummingbird (*Archilochus colubris*) has been the only member of the family Trochilidae known to occur in Ontario. On September 8, 1966, Mr. Daniel Kostachin obtained a hummingbird of uncertain identity near Winisk (55°16′ N, 85°12′ W, Kenora District, Ontario. Mr. Kostachin gave the specimen to Chief Michel Hunter of Winisk who in turn forwarded it to the Office of the District Forester at Sioux Lookout whence it was sent to the author at the Royal Ontario Museum for identification.

On the basis of plumage characters delineated by Ridgway (1911, *Birds of North and Middle America*, United States National Museum, Bulletin 50, pt. 5, p. 613) and comparison with study skins in the collection of the Department of Ornithology, the specimen proved to be that of a subadult male Rufous Hummingbird (*Selasphorus rufus*) and represents the first record of occurrence of this species in Ontario. Although partly damaged by shot it was possible to take the following measurements: bill (gonys), 14.3 mm.; wing (chord), 41.7 mm.; tarsus, 4.3 mm.; tail, 25.2 mm. The specimen is now number 99044 in the collection of the Department of Ornithology of the Royal Ontario Museum.

Godfrey (1966, *The Birds of Canada*, National Museum of Canada, Bulletin 203, p. 232) indicates that the Rufous

Hummingbird breeds no farther east than southwestern Alberta, in Waterton, Banff and Jasper National Parks. However, there are at least three records of non-breeding individuals from as far east as the Cypress Hills area of southwestern Saskatchewan (Potter, 1936, Condor, 38:170). They are as follows: a single bird obtained at Eastend on August 11, 1929; a single bird found at Eastend on August 18, 1932; and a single bird from near Shaunavon on July 31, 1933. Shaunavon, the previous easternmost locality in Canada, is approximately 1100 air miles from Winisk. In the United States in late fall and winter this species has occurred accidentally as far east as Charleston, South Carolina (one record, December 18, 1909; Sprunt, 1929, Auk, 46:237-38) and accidentally or as a rare winter visitant in Florida (at least nine records, 1932-1951; see Sprunt, 1954, *Florida Bird Life*, National Audubon Society, p. 267).

Weather records are no longer available for the Winisk area as the station there closed when the radar base ceased operations in 1965 (R. A. Baxter, personal communication). However data covering the period August 28 to September 12, 1966 from Churchill, Manitoba, and Moosonee, Ontario, indicate no unusual weather conditions in the general area. Winisk is approximately midway between the above two localities. Meteorological data for the prairie provinces show that an intense storm emanating strong westerly winds developed along the Alberta-Saskatchewan border on August 30. This storm moved steadily eastward reaching Ontario on September 4. Thus the hummingbird may have been carried to Winisk by this extensive front. As the Rufous Hummingbird apparently breeds northward at least to Atlin (59°31′ N, 133°41′ W) in northern British Columbia our specimen may have been either a fall migrant blown off course or a wanderer from the far north. If this individual came from a more southerly locality, and if not wind blown, its presence at Winisk might be interpreted as the result of random wandering from its birth place. Records of this phenomenon most often pertain to young of the year (Johnston, 1961, Condor, 63:386).

I wish to thank Messrs. Daniel Kostachin and Michel Hunter of Winisk and J. E. Barnes and R. A. Baxter (District Forester) of the Sioux Lookout Branch, Ontario Department of Lands and Forests for permission to publish this note and to retain the specimen in the collection of the Royal Ontario Museum. Messrs. Barnes and Baxter provided me with weather data for Churchill and Moosonee obtained by them from Mr. J. R. H. Noble, Director, Meteorological Branch of the Department of Transport of Canada. Mr. Robert R. Dodds of the above office provided weather data on the prairie provinces.

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Accepted December 28, 1966

A Black Bear Kills a Fawn

ON July 9, 1965, while studying blue grouse on Vancouver Island, I saw a black bear kill and eat the fawn of a Blacktail deer. This was in sub-alpine vegetation at approximately 3900 feet elevation. Here, clumps of mountain hemlock (*Tsuga mertensiana*) occur among heathers, grasses, and low shrubs. At 12.30 p.m., I stopped for lunch on a rocky outcropping. Suddenly a fawn burst from trees 40 feet to my right, crossed 100 feet of open meadow, and disappeared over a 30 foot rocky bank to my left. The fawn was followed by a large doe which was snorting, prancing, and at the same time appeared to be pawing the ground with her forefeet. She was looking back as she moved until I whistled. She turned and came towards

me. It was then that a second fawn suddenly appeared from the right between myself and the doe now only 20 feet away. Because the doe was so close and obviously angry, it was occupying my full attention and I did not observe what this fawn did next. However, it apparently turned about and headed back to my right and into view again. When this fawn was 50 feet away from me, a bear charged at it from under a mountain hemlock and in three bounds was upon the fawn. The fawn either dropped in front of the bear or was struck down by the bear's forepaws. Either way the fawn had time to give only a single bleat before dying. The bear immediately began eating the fawn. The doe, after pausing a moment and snorting, left in the direction of the first fawn. I followed the doe a short distance then climbed to a ledge 100 feet above the feeding bear. The bear dragged the fawn into nearby shrubs where it seemed to have less trouble holding the carcass as it ate. The bear held the fawn with its forepaws and tore chunks off the body with its teeth. The hide caused considerable trouble as it kept slipping from between the teeth of the bear when it attempted to tear off pieces. The bear continued to feed on the skin, flesh, and bones of the fawn until 1.35 p.m. when I chased it away by throwing rocks and shouting. Apparently this was the first time that the bear was aware of my presence. It carried nothing with it as it disappeared. At the site of the kill I was able to locate one foot of the fawn. Other than this there was no evidence that a predator had made his kill, eaten, and left. Using the toe cap of the hoof, I estimated the fawn at 20 days of age. The bear appeared to weigh approximately 250 to 300 pounds. In conclusion, I wish to stress that the attack may not have occurred had I not attracted the attention of the doe.

There are few reports in the literature of fawn predation by black bears. However, predation on elk calves by black bear was reported by Johnson (1951) and Howell (1921) and predation on fawns was reported by Trippensee (1948:172), Levin (1954), Resner (1954), and Grinnell et al. (1937).

I wish to extend thanks to Dr. J. F. Bendell and Charles Jonkel for assistance in the preparation of this manuscript.

References

GRINNELL, J., J. S. DIXON and J. M. LINSDALE. 1937. Fur-bearing mammals of California. University of California Press. Volume 1: 375 pp.

HOWELL, A. B. 1921. The black bear as a destroyer of game. Journal of Mammalogy 2(1): 36.

JOHNSON, D. E. 1951. Biology of the elk calf *Cervus canadensis nelsoni*. Journal of Wildlife Management 15(4): 396-410.

LEVIN, O. H. 1954. The south Olympic tree farm. Journal of Forestry 52(4): 243-249.

RESNER, O. H. 1954. Damage to conifers by bear. Proceedings of the 33 American Conference of the Western Association of the State Game and Fish Commission 33: 109-111.

TRIPPENSEE, R. E. 1948. Wildlife management. McGraw Hill Co. Inc., New York. 479 pp.

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Notes on the Gull Colonies of Prince Edward Island

IN 1965 and 1966, an effort was made to locate and examine all gull colonies on Prince Edward Island. In the 1966 field season, 33 tern colonies and seven gull colonies were examined. While the writer does not rule out the possibility of other gull colonies on the Island, all areas considered suitable for nesting were visited.

The following is a list of gull colonies observed in the 1966 field season with some notes from previous years.

Little Courtin Island, Malpeque Bay, Prince County. Vass (1965, The Canadian Field-Naturalist 79(2): 152-154) visited this colony in 1964. He recorded a colony of some 800 Great Black-backed Gulls, *Larus marinus*. On July 2, 1966, the writer visited this colony and found on the northern portion of the island a mixed colony of *Larus marinus* and Herring Gulls, *Larus argentatus*, predominately Great Black-backed Gulls. I counted 294 occupied nests and 206 empty nests. The southern tip of the island had a colony of 250 Herring Gulls, consisting of 35 occupied nests and 27 empty nests. A large tern colony of 515 occupied and 27 empty nests was noted between the two gull colonies.

Bird Island, Malpeque Bay, Prince County. I carefully searched this island and found no evidence of a colony. Vass (*loc. cit.*) in 1964 found 100 nests of the Herring Gull on the central portion and some 60 nests of the Great Black-backed Gull on the northeastern shore of this island. Identification of these 60 nests was based on their larger size and the presence of one *Larus marinus* egg found in a nest. The presence of Herring Gulls on Little Courtin Island in 1966 may be explained by their absence from Bird Island.

Cascumpeque Islands, Cascumpeque Bay, Prince County. On July 9, 1966, two of these islands had nests of *Larus marinus*. The writer counted a total of 47 nests only three of which were occupied. Fifty adult birds were counted, and two young birds were seen hiding in the grass.

Brae Island, Prince County. This colony contained 175 nests of which 121 were empty. This was thought to be predominantly a Herring Gull colony as only one pair of Great Black-backed Gulls was observed on July 10, 1966.

Pownal Islands, Pownal Bay, Queens County. On July 4, 1966, the east island of this group contained a small colony of *Larus marinus*. Nine nests (only one occupied), 14 young, and 40 adults were counted. On July 4, 1965, less than half this number were present. On July 4, 1966, on these three islands I counted 99 tern nests (occupied), a considerable decrease from the year before.

Murray Islands, Kings County. On June 25, 1966, I visited these islands. The northeast island had a mixed colony of *Larus marinus* and *Larus argentarus*. One hundred sixty-eight nests were counted of which 27 were occupied. The number of adult gulls seen here was estimated at over 500. Sixty-six young were seen running about.

Gull Island, Savage Harbour, Kings County. On June 7 and 14, 1964, I observed a single nest of *Larus marinus* near this island. The nest held two eggs. A nest was constructed in 1965 but a visit on June 6, and later visits failed to reveal any eggs.

On an island, one and one-half miles east of Conway Inlet, Prince County, I observed one empty gull nest. There were no adults in the vicinity.

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Accepted November 18, 1966

Occurrence of The Fulvous Tree Duck in Canada

IN recent years, the Fulvous Tree Duck (*Dendrocygna bicolor*) has extended its range east and north from its traditional range in Mexico, Louisiana, Texas, and California. Numerous sightings have been made in the eastern United States. This note incorporates all known published records for Canada and adds four unpublished observations, including the first one for Quebec.

Until 1955 there was only one record of its occurrence in Canada, a specimen now in the British Columbia Museum shot on September 29, 1905, at Alberni, B.C.

The earliest Quebec record is from Lake St. Peter, near Nicolet, Quebec. In

late September or early October, 1955, a flock of about 25 landed in a set of decoys. Six were shot by the hunters; one was mounted and donated to the Laval University museum by Mr. Paul Gendron (personal communication). Other autumn Quebec sightings include five observed on the Ottawa River, near Thurso, in mid-September, 1964, and a single bird observed in the same location in August, 1966 (J. C. Wilson, personal communication). The only spring occurrence I know of in Quebec is of a bird that I saw near Thurso on May 12, 1965.

The first New Brunswick record is of a flock of 21 observed on Grand Manan Island on November 4, 1961. On November 21, six were seen in Kings County, N.B., and five were shot. Four of the five (three males and one female) are now in the New Brunswick Museum (Squires, 1962). A specimen collected from a group of three on November 27, 1962, at Frenchman Bay constitutes the first Ontario record (Woodford, 1963a). The first Canadian spring record was of one seen at Fanshaw Lake, near London, Ontario, from April 7 until early May, 1963 (Woodford, 1963b). During the autumn of 1962 one was seen at 100 Mile House, B.C. (Rodgers, 1963). There is no Canadian breeding record for the Fulvous Tree Duck.

References

RODGERS, T. H. 1963. Northern Rocky Mountain—Inter-mountain Region. Audubon Field Notes 17(1): 51.

SQUIRES, W. A. Fulvous Tree Duck in New Brunswick. The Canadian Field-Naturalist 76(2): 120.

WOODFORD, JAMES. 1963a. Ontario-Western New York Region. Audubon Field Notes 17(1): 29-30.

————. 1963b. Ontario-Western New York Region. Audubon Field Notes 17(4): 400.

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Buff-breasted Sandpiper in New Brunswick

DURING the afternoon of September 11, 1966, I noted a Buff-breasted Sandpiper *Tryngites subruficollis* (Vieillot) on the east bank of the Saint John River at Fredericton, New Brunswick. It was feeding along the water's edge with Pectoral, Least, and Semipalmated Sandpipers. Near by were Spotted and Solitary Sandpipers as well as Greater and Lesser Yellowlegs with which to compare and contrast. After a short while, it detached itself from the other birds and began foraging alone on the open shore away from the river. Optical aids were soon discarded as the bird allowed approach to within a few yards. The bird was very pale below and I assumed it to be in nonbreeding plumage. It remained until the morning of September 13 and was seen by several local amateur naturalists. It is readily identifiable in color photographs taken by Dr. W. Austin Squires. This is the first known occurrence of the species in New Brunswick.

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Accepted November 1, 1966

Range Extension of the Harris' Sparrow

ON August 7, 1965, while searching for Ross' Geese, *Anser rossii* Cassin, in the vicinity of the Queneau River, N.W.T. (67′ 47″ N, 103′ 9″ W), approximately 35 miles west of the Perry River, I observed an adult and three young Harris' Sparrows, *Zonotrichia querula* (Nuttall), about 500 yards from the river on a grassy embankment. An adult was observed feeding the young on two occasions, but at no time were both adults seen together. This behavior indicates the birds probably bred in the immediate

area; however, as the young were capable of fairly strong flight, this cannot be stated with certainty.

The Harris' Sparrow breeds "from the northwestern and central eastern Mackenzie (Mackenzie Delta, Kahduonay and Crystal islands) and southern Keewatin (Sandhill Lake) south to northeastern Saskatchewan (Cochrane River) and northern Manitoba (Du Brochet, Bird); casually east in summer to northwestern Ontario (Fort Severn)" according to the A.O.U. Checklist of North American Birds (1957, 5th Ed., p. 618). A northeastern extension of this breeding range was provided by Clarke (1944, Canadian Field-Naturalist, 58:97-103) when he observed adults and young of the year at Burnside River near Bathurst Inlet, Mackenzie. McEwen (1957, Canadian Field-Naturalist, 71: 109-115) reported that this species was fairly common at Bathurst Inlet in 1950. He did not find any nests but judged "from the activity of the females the young had left the nest by about July 18." The Royal Ontario Museum has a specimen collected on May 20, 1950, at Eskimo Point on Hudson Bay (Snyder, 1957, Arctic Birds of Canada, Toronto).

This record provides an approximately 150 mile northeastern extension of the previously documented distribution of this species and possibly also a new breeding record.

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NEWS AND COMMENT

The Honourable Mr. Arthur Laing Proposes formation of a National Nature Trust

In a speech delivered on January 14, 1967 before the Canadian Audubon Society in Toronto, the Honourable Arthur Laing, Minister of Indian Affairs and Northern Development, suggested the formation of a *National Nature Trust* such that would accept donations of land "which would be of value in the preservation of wildlife habitat". At present, some machinery exists for accepting gifts to the Crown, but in the context of wildlife habitat, game preserves and sanctuaries, there is no established procedure spelled out.

In his address, Mr. Laing outlined some of his Department's responsibilities in the field of wildlife management and research. Many naturalists may not be aware that the management of wildlife in the provinces (other than migratory birds) is not a federal responsibility, although the federal government may extend co-operation to the provinces at their request. Among the Department's many concerns are arctic wildlife, including the Polar Bear, the Barren-ground Caribou, the Musk ox and, of course, waterfowl in all parts of Canada. Present-day research and concern are being directed especially at those species of wildlife that have suffered severe decreases in numbers in recent years due to various kinds of increased pressures from man. For many species recent decreases are due largely to destruction of their habitat. It is clear that selected lands set aside as Nature Trusts would provide one good answer for ensuring that such species are not reduced to dangerously low levels.

In the Prairie Provinces, pilot projects have now been carried out where agreements have been made with landowners for the preservation, in their natural state, of the vitally important potholes which are the breeding grounds for so many of North America's ducks. Some ducks such as the canvasback, the redhead and even the mallard have recently experienced sharp population decreases. Though these species tend to decline and then recover, the long term trend is downward. Among the causes of decline, an important one is drainage of the breeding grounds. The basis for the pilot agreements is that in return for a payment based on the value of the surrounding land, the landowners agree not to drain or fill the wetlands concerned or to destroy the natural vegetation around them. Whether this program can be expanded soon enough to prevent severe losses of many valuable duck species is not yet known.

It is clear that the main purpose of a National Nature Trust would be the preservation of many forms of life in reasonable abundance by preserving the all-important and often very fragile habitat. The National Parks are, of course, the largest areas held in trust today by the Federal Government. These Parks, however, total only 0.8 per cent of Canada's total land area and are not adequate to ensure the preservation of Canada's many kinds of wildlife against extinction. For example, the Black-footed Ferret, the Kit Fox, and

the Prairie Dog are now restricted to only one small area in Saskatchewan. Yet this area is not a Park and is scarcely protected.

Mr. Laing suggested that we think about extending the trustee role of the Government so that those who own nature preserves, bird sanctuaries and such can be certain that such assets can be preserved for generations to come. The Department is presently looking into the implications of gifts and of purchases for a nominal sum, of areas which meet the necessary requirements.

Mr. Laing also stated that he was concerned that we are not making a national effort to ensure the preservation of undisturbed samples of all the different sorts of natural areas included in Canada. Although the National and Provincial Parks meet this need in part, many gaps are evident. Natural Area Preserves would serve as important research facilities (see Book Review Section on page 143) and would, of course, have the added function of serving as living museums of Canada's past. Perhaps their most important function would be the preservation of a home for some of the more retiring members of our wildlife fauna, such as the smaller mammals, birds, amphibians, reptiles, and even insects. These preserves would presumably be located across the country rather than be restricted to a few areas which qualify for park status. Such special nature reserves are presently being set aside in the United States, Britain and the Netherlands. Copies of Mr. Laing's speech may be obtained by writing to the Information Service, Department of Indian Affairs and Northern Development, Ottawa.

Editor

Secretary Udall Names 78 Endangered Wildlife Species

A sign of the changing natural history of our times is indicated by the fact that 78 mammals, birds, reptiles, and fishes in the United States were listed by Secretary of the Interior, Stewart L. Udall, as being threatened with extinction. The tabulation is the first to be made under the Endangered Species Preservation Act of 1966 (Public Law 89-669).

Every state and over 300 individuals and organizations across the nation were consulted to determine the species threatened with extinction. The key list was compiled after considering recommendations by members of the scientific and academic fraternity specializing in wildlife studies.

According to the law, a species is considered endangered when its habitat is threatened with destruction, drastic changes, or severe reduction, or when the animals are subjected to over exploitation, disease, or predation.

"An informed public will act to help reduce the dangers threatening these rare animals," Secretary Udall said in naming 14 mammals, 36 birds, 6 reptiles and amphibians, and 22 fishes.

The following list shows the species threatened with extinction and in need of assistance:

ENDANGERED SPECIES

Mammals (14)

Indiana Bat	*Myotis sodalis*
Delmarva Peninsula Fox Squirrel	*Sciurus niger cinereus*
Timber Wolf	*Canis lupus lycaon*
Red Wolf	*Canis niger*
San Joaquin Kit Fox	*Vulpes macrotis mutica*
Grizzly Bear	*Ursus horribilis*
Black-footed Ferret	*Mustela nigripes*
Florida Panther	*Felis concolor ceryi*
Caribbean Monk Seal	*Monachus tropicalis*
Guadalupe Fur Seal	*Arctocephalus philippi townsendi*
Florida Manatee or Florida Sea Cow	*Trichechus manatus latirostris*
Key Deer	*Odocoileus virginianus clavium*
Columbian White-tailed Deer	*Odocoileus virginianus leucurus*
Sonoran Pronghorn	*Antilocapra americana sonoriensis*

Birds (36)

Hawaiian Dark-rumped Petrel	*Pteredroma phaeopygia sandwichensis*
Hawaiian Goose (Nene)	*Branta sandvicensis*
Aleutian Canada Goose	*Branta canadensis leucopareia*
Tule White-fronted Goose	*Anser albifrons gambelli*
Laysan Duck	*Anas laysanensis*
Hawaiian Duck (or Koloa)	*Anas wyvilliana*
Mexican Duck	*Anas diazi*
California Condor	*Gymnogyps californianus*
Florida Everglade Kite (Florida Snail Kite)	*Rostrhamus sociabilis plumbeus*
Hawaiian Hawk (or Ii)	*Buteo solitarius*
Southern Bald Eagle	*Haliaeetus l. leucocephalus*
Attwater's Greater Prairie Chicken	*Tympanuchus cupido attwateri*
Masked Bobwhite	*Colinus virginianus ridgwayi*
Whooping Crane	*Grus americana*
Yuma Clapper Rail	*Rallus longirestris yumanensis*
Hawaiian Common Gallinule	*Gallinula chloropus sandvicensis*
Eskimo Curlew	*Numenius borealis*
Puerto Rican Parrot	*Amazona vittata*
American Ivory-billed Woodpecker	*Campephilus p. principalis*
Hawaiian Crow (or Alala)	*Corvus tropicus*
Small Kauai Thrush (Puaiohi)	*Phaeornia palmeri*
Nihoa Millerbird	*Acrocephalus kingi*
Kauai Oo (or Oo Aa)	*Moho braccatus*
Crested Honeycreeper (or Akohekohe)	*Palmeria dolei*
Akiapolaau	*Hemignathus wilsoni*

Kauai Akialoa	*Hemignathus procerus*
Kauai Nukupuu	*Hemignathus lucidus hanapepe*
Laysan Finchbill (Laysan Finch)	*Psittirostra c. cantans*
Nichoa Finchbill (Nihoa Finch)	*Psittirostra cantans ultima*
Ou	*Psittirostra psittacea*
Palila	*Psittirostra bailleui*
Maui Parrotbill	*Pseudonestor xanthophrys*
Bachman's Warbler	*Vermivora bachmanii*
Kirtland's Warbler	*Dendroica kirtlandii*
Dusky Seaside Sparrow	*Ammospiza nigrescens*
Cape Sable Sparrow	*Ammospiza mirabilis*

Reptiles and Amphibians (6)

American Alligator	*Alligator mississippiensis*
Blunt-nosed Leopard Lizard	*Crotaphytus wislizenii silus*
San Francisco Garter Snake	*Thamnophis sirtalis tetrataenia*
Santa Cruz Long-toed Salamander	*Ambystoma macrodactylum croceum*
Texas Blind Salamander	*Typhlomolge rathbuni*
Black Toad, Inyo County Toad	*Bufo exsul*

Fishes (22)

Shortnose sturgeon	*Acipenser brevirostrum*
Longjaw cisco	*Coregonus alpenae*
Piute cutthroat trout	*Salmo clarki seleniris*
Greenback cutthroat trout	*Salmo clarki stomias*
Montana Westslope cutthroat trout	*Salmo clarki*
Gila trout	*Salmo gilae*
Arizona (Apache) trout	*Salmo* sp.
Desert dace	*Eremichthys acros*
Humpback chub	*Gila cypha*
Little Colorado spinedace	*Lepidomeda vittata*
Moapa dace	*Moapa coriacca*
Colorado River squawfish	*Ptychocheilus lucius*
Cui-ui	*Chasmistes cujus*
Devils Hole pupfish	*Cyprinodon diabolis*
Comanche Springs pupfish	*Cyprinodon elegans*
Owens River pupfish	*Cyprinodon radiosus*
Pahrump killifish	*Empetrichythys latos*
Big Bend gambusia	*Gambusia gaigei*
Clear Creek gambusia	*Gambusia heterochir*
Gila topminnow	*Poeciliopsis occidentalis*
Maryland darter	*Etheostoma sellare*
blue pike	*Stizostedion vitreum glaucum*

The importance of this list to Canadians is at once apparent. The list serves as an advance warning that despite the vastness of a country, many kinds of wildlife resources may be in danger of extinction. It is hard to believe that the timber wolf in the United States is threatened with extinction and *in need of assistance!* Yet, in the Province of Quebec a vast strychnine poisoning program to "get rid" of this species is under way. As of this writing, the province of Ontario is under strong pressure to begin a program that would virtually eliminate the wolf from the Ontario landscape.

Copies of the Endangered Species Preservation Act together with related information may be obtained from the Bureau of Sport Fisheries and Wildlife, Department of the Interior, Washington, D.C.

EDITOR

A MATTER OF SOME PRIDE

ONE MEASURE of the value of THE CANADIAN FIELD-NATURALIST (now in its 87th year of continuous publication) is the number of times that it is cited by persons who are writing books designed for use not only of specialists but also of the general public. It is of more than passing interest to learn that about one-third of the selected references in W. Earl Godfrey's new book THE BIRDS OF CANADA (see book review in this issue by Roger Tory Peterson) and about one-tenth of the references in Ronald L. Peterson's new book, THE MAMMALS OF EASTERN CANADA (review to appear in a forthcoming issue), concern papers published in THE CANADIAN FIELD-NATURALIST. The publication in this journal of so many useful papers on Canadian natural history affords a fine contribution indeed to the advancement of science and to the education of the general public, particularly in view of the many excellent journals available today for the publication of research results. These and other papers are, of course, a permanent record of the natural history of this part of the world. This record cannot be duplicated so that the journal will continue to be cited a great deal in the future. Naturalists of this country can be justly proud of the long and continuous support that they have extended to this journal through membership and through the offering of manuscripts.

EDITOR

AMERICAN MALACOLOGICAL UNION MEETINGS

The American Malacological Union (the North American scientific society for the study of mollusks) will meet at Carleton University and the National Museum from July 31 to August 4, 1967. For information contact A. H. Clarke, Jr., National Museum of Canada, Ottawa.

SPECIAL NOTICES

CANADIAN ORCHID SURVEY PROJECT

A group of members of the Ottawa Field-Naturalists' Club has begun a long-term project to accumulate sight records of occurrences of native Canadian orchids and to prepare easily usable consolidated listings of the sites. The method involves field work by each participant, the recording of species, abundance, and location in an agreed format, and the submission of lists of data to a coordinator for collation and consolidation in a master list at the end of each growing season.

The aim of the project is to obtain detailed information on distribution, population changes and habitat characteristics, particularly at the limits of species' ranges. This kind of research, since it can involve extensive field work, is usually too time-consuming for professional botanists. Each site is recorded within a distance on the ground of 100 metres, by quoting a numerical map reference.

During the summer of 1966, field work was conducted principally within driving distance of Ottawa. Three teams of observers were able to locate 37 species at a total of 913 localities.

Knowledge obtained concerning distributions of orchids could be used in connection with preservation activities, especially near our more urbanized regions. If it is known, for example, that a particular locality contains a rare species, or that the locality contains many species, a stronger case can be made for legal preservation or protection of the site. Sites rich in orchids often contain other rare or interesting kinds of plants. The presence of such plants can provide further justification for establishing legal protection for such sites.

Since orchid localities, if known, are often raided, the listings obtained in this study will not be widely circulated. It is intended to deposit copies with the herbaria of the National Museum of Canada and the Department of Agriculture in Ottawa, and to selected university departments, in addition to the copies received by participants. In the Ottawa area lists of species and localities within the Ottawa Greenbelt and Gatineau Park will be supplied to the National Capital Commission, since in many instances damage to a site rich in orchids can be prevented if the locality is known.

Participants from all parts of Canada are cordially invited. Persons wishing to undertake serious work on this project should write to the project coordinator.

MR. E. W. GREENWOOD

P.O. Ramsayville,
Ontario.

NEST RECORD CARD PROGRAMS IN CANADA

IN JANUARY 1965 the Laboratory of Ornithology at Cornell University launched its nest record card program on a continent-wide basis. The basic objective of the program is to collect, analysis and distribute statistical information on the breeding biology of birds. In essence the scheme is very simple. Each observer fills out a card (see Figure 1) recording data noted for every active nest found. The North American Nest Record Card Program was by no means the first such program and Canada is fortunate in having almost complete coverage by regional programs. These are listed below: —

NAME OF PROGRAM	AREA COVERED	NAME AND ADDRESS OF REGIONAL CENTER
Maritime Provinces Nest Records Scheme	Nova Scotia, P.E.I., New Brunswick	Canadian Wildlife Service, P. O. Box 180, Sackville, N.B.
Province of Quebec Society for Protection of Birds Nest Records	Quebec	D. E. Sergeant, R.R. No. 1, Como, Hudson, Quebec
Ontario Nest Record Scheme	Ontario	Department of Ornithology, Royal Ontario Museum, Toronto
Prairie Nest Records Scheme	Manitoba, Alberta, Saskatchewan	Sask. Natural History Society, Box 1121, Regina, Sask.
Pacific Nest Records Scheme	Yukon, British Columbia	Department of Zoology, University of British Columbia, Vancouver

Our aim at Cornell is to provide a central clearing house for this type of information collected throughout Canada and the United States. We are working on the problems of storage, retrieval and analysis of this data by means of a computer. It would not be feasible for regional programs to undertake this individually. One of the most satisfactory aspects of our work has been the friendly co-operation we have received from other programs. There is an obvious advantage to us in working with regional programs. The organizers can distribute cards and screen contributors more effectively than would be possible for us to do. We have already made a start on copying the data collected by the regional programs. In turn we hope that we will be able to provide information to those studying avian breeding biology that would not be possible for any individual program to provide. The North American Nest Record Card Program also provides coverage for many areas of the United States that do not have regional programs. We urge all observers to send in cards on all active nests found to their regional programs. The success of the program depends on active support of a large number of persons and it should be remembered that cards on a common species are more useful than those on rarities.

DO NOT USE | NORTH AMERICAN NEST RECORD CARD PROGRAM | YEAR | ALTITUDE OF LOCALITY

SPECIES

NAME OF OBSERVER

IF NEST WAS PARASITIZED BY COWBIRD, CHECK HERE
AND FILL OUT A SEPARATE CARD FOR COWBIRD

LOCALITY

COUNTY

STATE

HEIGHT OF NEST ABOVE GROUND
TO NEAREST WHOLE FOOT

DATE	B	EGGS	YOUNG	COMMENTS

PLEASE FOLLOW INSTRUCTIONS ON REVERSE

SITE (check one)
1. ground
2. grass or marsh vegetation
3. bush
4. cactus
5. tree - deciduous
6. - conifer
7. - palm
8. snag
9. building
10. fence post
11. nest box
12. cliff
13. other (specify)

HABITAT (check one)
1. urban
2. marsh - salt
3. - fresh
4. - brackish
5. swamp
6. orchard
7. woodland - conifer
8. - deciduous
9. - mixed
10. desert
11. shore
12. field - cultivated
13. - uncultivated
14. grassland
15. tundra
16. other (specify)

FRONT

INSTRUCTIONS: PLEASE FOLLOW CAREFULLY

1. Use separate card for each nest. During nest-building, check column B. Count eggs and/or young when possible. All active nests, whether successful or not, should be reported. Use separate card for each re-nesting of the same pair during the year.
2. Record only one visit per day unless a change has taken place between same-day visits.
3. Species: use FULL common name, as in Peterson's Field Guides or the A.O.U. Checklist.
4. Observer: last name first, then given name. (Don't use name of bird club here.)
5. Date: month in letters, not numerals!
6. Altitude: (if known) in feet above sea-level
7. Locality: nearest village or city
8. Site and Habitat: Check one for each column. (A swamp is a heavily wooded flooded area, more frequent in the south; a marsh is an open flooded area.)
9. Use Care! Do not disturb nest more than absolutely necessary, because disturbed nests may be found by predators. The program is primarily for adults; children may participate only under direct and constant adult supervision.
10. It is important that the cards be both accurate and as complete as possible.
11. Completed cards should be sent, at the end of the breeding season, to your regional center, or to: The LABORATORY OF ORNITHOLOGY, 33 Sapsucker Woods Road, Ithaca, New York 14850. Be sure to include your return address. Cards may be sent by parcel post.

WE THANK YOU FOR CONTRIBUTING YOUR TIME AND EFFORTS TO THIS PROGRAM

REVERSE

Information can be obtained from the cards on four major facets of a species' breeding biology. These are the extent of, and peaks in, the breeding season, clutch-size, breeding success, nest site and habitat. These factors naturally inter-relate with each other. For common species it will be possible to plot the breeding season for individual years and thus determine the influence of weather on the breeding. The variation of clutch-size during the breeding season can be readily determined. Both the hatching and fledging success can be calculated from cards. The relationship of breeding success to habitat, breeding season and clutch-size can be considered. Much has been said about

the lack of breeding success owing to pesticides. With a large amount of data and central analysis of these data it will be possible to follow trends in breeding success. Facts would replace speculation.

I hope that I have managed to give some idea of the value of nest record card programs and that many more persons will support them. Any observer who find any active identifiable nest can make a contribution to a nest record card program.

David B. Peakall,
Laboratory of Ornithology,
Cornell University, Ithaca,
New York

The CANADIAN FIELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

Editorial

Articles

(*Continued on outside back cover*)

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THE OTTAWA FIELD-NATURALISTS' CLUB

FOUNDED IN 1879

The objectives of the club are to foster an acquaintance with and a love of nature, to encourage investigation and to publish the results of original research and observations in all branches of natural history.

The club is a corporate member of the Federation of Ontario Naturalists and is affiliated with the American Association for the Advancement of Science.

THE CANADIAN FIELD-NATURALIST

The Canadian Field-Naturalist is published quarterly with the assistance of affiliated societies and of a contribution from the Canadian National Sportsmen's Show. Manuscripts representing observations or the results of original research in any branch of natural history are invited. Contributions to the Letters and to the News and Comment sections are welcome. All material intended for publication should be addressed to the editor. Opinions and views expressed in this journal are private and do not necessarily reflect those of The Ottawa Field-Naturalists' Club or of any other agency.

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The Canadian Field-Naturalist

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A NATIONAL CONSERVATION FOUNDATION

THERE IS A GROWING NEED IN CANADA for a new kind of institution in the conservation field – one that would provide a stable financial basis for the support of private conservation efforts. The need for more money for conservation work, particularly for educational aspects, is underlined by recent events such as the large scale pollution of Lake Erie, the rapid deterioration of other Great Lakes and of many of our rivers, the continuing province-wide poisonings of wildlife in New Brunswick and in other areas, the failure of Ontario and Quebec to dedicate their most outstanding landscapes to the National Parks System and the loss of far too many park-like areas near our cities, areas that are badly needed to serve as recreational facilities for rapidly increasing urban populations.

By far the most serious of these conservation failures concerns the increasing levels of pollution and contamination of our environment by enormous amounts of industrial and municipal wastes and by non-degradable pesticide poisons. It is a fact that pollution levels are increasing steadily at a time when technological know-how to deal effectively with this problem is available. The losses from pollution to property values, to recreation values and to clear waters and horizons are enormous; the effects on our wildlife heritage are tragic. It is not in the interest of man to create blighted areas over larger and larger parts of this continent. The time has come to find new or more effective ways to inform people about what is happening to our environment.

Some Canadian conservation organizations that already have developing programs in conservation education are the Canadian Wildlife Federation, the Canadian Audubon Society, the Canadian Society of Wildlife and Fishery Biologists, the National and Provincial Parks Association of Canada, the Conservation Council of Ontario, the Federation of Ontario Naturalists, the Saskatchewan Natural History Society, the British Columbia Nature Council and many sportsmen's and naturalists' groups. The Canadian Wildlife Federation, for example, sponsors "Wildlife Week" and makes available some literature to our school systems. The Canadian Audubon Society and other groups sponsor the well-known Audubon lectures and films.

All these organizations are operating on small budgets and limited staff. Considering the immense importance of their work, they are deserving of a far greater degree of financial support. The needed level of support has not been available because a very large segment of the public is unaware of these organizations or of the potential value of their work to society. These organizations find themselves caught in a self-perpetuating cycle from which it has, so far, been impossible to escape. Funds are not forthcoming because too many persons find conservation issues to be intangible and complex, while on the other hand, the pressing conservation problems of today are not easily comprehended by the public because of woefully inadequate public-oriented conservation education. A fresh infusion of funds is needed to break this cycle.

What Canada now needs is a National Conservation Foundation that is set up specifically for financing imaginative conservation education programs on a national scale. Such a foundation could be supported by private and corporate wealth or by the government or by some combination of these. The foundation would do for conservation what the Canada Council is doing for the arts, and what the National Research Council is doing for some of the sciences. The plain fact is that the conservation of our natural resources is now a matter of vital importance to the

Mailing date of this number: 12th December, 1967

happiness and the well-being of all Canadians. But yet, the majority of people are either uninformed or misinformed about the true costs or implications of conservation failures. *Conservation is a political matter, and an informed and concerned public is therefore vital to solve conservation problems.* It is significant that every major resource conference in recent time has stressed the need for the development and growth of conservation education programs. Because of the gravity and scale of our recent conservation failures it is clear that such programs have been far too slow to develop.

A National Conservation Foundation if it were privately supported would clearly be a fund-raising organization. Its major objective would be to finance the educational programs of existing conservation organizations and so enable these programs to expand in a systematic, co-ordinated and secure manner. The foundation might also provide grants for the construction of much needed natural science and conservation schools, provide scholarships and support for modern research into problems of recreation, urban planning, pollution, pesticides, parks of all types and so on. If the foundation were private, it would be in a position to support some studies in "politically sensitive" areas, studies that governments are, understandably, reluctant to make. A private foundation could probably be most effectively launched by the joint initiative of a number of organizations in consultation with a few concerned, practical and philanthropic leaders of the business community. Since the foundation would have to be "sold" to Canadians, particularly to businessmen, the individuals charged with its formation would have to combine personal magnetism and a good knowledge of modern communications media with a conviction of the necessity for such an institution. If sufficient private wealth could not be found then it should become the responsibility of government to see that such a foundation is supplied with funds. For one possible model we might look to Great Britain where the Nature Conservancy (a government agency) is a body which is concerned with public education, with the preservation of land for recreational and other purposes and with research in the environmental sciences.

The need for a foundation to support conservation work in Canada was stressed recently by Mr. Walter Gray, Chief of the Ottawa Bureau of the Toronto Star in a speech given at the 1966 annual meeting of the Canadian Wildlife Federation. Mr. Gray suggested the formation of a "National Wildlife Foundation" that would be "free to engage itself in those matters that are of general public interest, concentrating on subjects that would mobilize the information-education processes to achieve an informed public opinion." Mr. Gray also suggested that such a foundation could be more broadly based, embracing the whole field of conservation. More recently, Mr. Gavin Henderson, editor of "Park News" the official publication of The National and Provincial Parks Association of Canada, also suggested the need for a National Conservation Foundation. Mr. Henderson points out that "except for the remarkable record of the Canadian National Sportsmen's Show in raising money for conservation education – about one and one-half million dollars since 1948 – there is no sustained source of funds in Canada at the present time to help make sure that in developing our land and its resources over the next hundred years we shall do so wisely and with a greater sense of responsibility to the future than we have shown in the past." Mr. Henderson suggests that the foundation be established by private and public subscription and be capitalized to make grants up to a total of two hundred and fifty thousand dollars a year to start.

The formation of a National Conservation Foundation should be a goal for all Canadians who are concerned about the quality of future environments in this country. Like the creation of the Canada Council and of the National Research Council, the establishment of such a foundation would be in the very best national interest of Canada.

THEODORE MOSQUIN

DRABA SIBIRICA (PALL.) THELL. IN NORTH AMERICA

A. E. PORSILD
National Museum of Canada, Ottawa, Ontario

IN THE CANADIAN FIELD-NATURALIST (Porsild, 1964, p. 96) I reported *Draba sibirica* as new to North America. My report was based on material collected in 1963 in the Ogilvie Mts., Yukon Territory, on alpine slopes along the Dempster Road, east of Mile 52, by Messrs. P. M. Youngman and G. Tessier of the Zoology Section, National Museum of Canada, who brought to me miscellaneous plant material regularly "harvested" by the vole, *Microtus gregalis*. Among this were a few flowering and fruiting shoots that, even in their fragmentary state, clearly showed the stoloniferous habit of *Draba sibirica* then not known from North America. Because these specimens were unsatisfactory for a photograph, I illustrated my article with a reproduction of the well-known and very excellent drawing published by Gelert (1898, Figure 9), giving full credit to its author.

In July, 1964, E. Hultén visited the same locality in the Ogilvie Mountains and reported (Hultén 1966) that he had collected abundant material of the *Draba* reported by me, observing also that it is "abundantly different from *D. sibirica* by its larger and glabrous or slightly pubescent leaves, its larger cauline leaves, its glabrous, distinctly three-nerved calyx, long, divaricate fruiting pedicels, and larger silicles with longer slender style. *D. sibirica* is scapose". In view of these alleged differences, Hultén believed this *Draba* distinct and described and illustrated it as *D. ogilviensis* n.sp.

In the summer of 1966, Mr. R. T. Porsild of Whitehorse, Y.T. made extensive collections of plants in the Ogilvie Mountains where he paid particular attention to this interesting "new" *Draba* which he found very common locally, not only in alpine situations east of Dempster Road, but also in the pass east and west of the road where it flowered from mid-June to the end of August. He also noted that it varied greatly according to habitat, altitude and exposure, and illustrated these variations by large series of specimens. These collections, now in the National Herbarium of Canada, show that on moist herbmat slopes in the pass (elev. 3800 ft.) this *Draba* is loosely tufted, with an abundance of slender, leafy stolons. The earliest flowers apparently rise terminally from leafy shoots formed at the end of the previous growing season. By elongation of the internodes, such terminal peduncles often bear one or more leaves. Flowers produced later, commonly rise in the axils of branching shoots and their peduncles therefore are naked or "scapose". At low to middle elevations the entire plant at first is totally glabrous (R. T. Porsild, No. 9, June 26) whereas leaves produced later in the season (idem, No. 341, July 26) show long, simple, forked or repeatedly branched hairs, especially along the leaf margins, but often also on the leaf surfaces. The flowering peduncles of early flowers tend to be completely glabrous, whereas those of later flowers are thinly covered by variously branched short trichomes of which some are 2-forked, sessile and attached in the middle and thus truly malpighiaceous, while most are stalked, variously forked or branched.

Plants collected in herbmats at elevations up to 4800 ft. or over may still be quite similar to those of lower elevations, except that the sepals, and sometimes even the young ovaries, tend to bear a few simple hairs (idem, No. 167 and No. 141, July 12).

At elevations of 6500 ft., in damp moss of crannies of rock talus the most striking variations where found (idem, No. 141, July 12). Here the plants formed polsters or soft cushions of loosely packed branches covered by densely imbricated leaves, and terminating in a naked peduncle*. Plants of high alpine situations commonly are more hirsute than those of lower elevations, especially along the leaf-margins that are often fringed by long, mostly simple hairs although variously branched hairs are by no means lacking; the pubescence of the flowering peduncles is composed mainly of simple hairs as is that of the sepals. The series collected by R. T. Porsild show considerable variation also in the colour of the petals that varies from deep to pale yellow.

R. T. Porsild reported abundant production of seeds, and a sample collected on August 4 readily germinated in the greenhouse of the Plant Research Institute, Central Experimental Farm, Ottawa, where Mr. G. A. Mulligan reported (verbal communication) it to be diploid ($2n = 16$) which is in agreement with counts reported by T. W. Böcher (1966, p. 34) for *D. sibirica* (Pall.) Thell.

Hultén (l.c.) described the sepals of *D. ogilviensis* as 3-nerved. To me the sepals of the Ogilvie Mt. plants appear quite nerveless and only when boiled material is viewed in translucent light, can faint "nerves" be detected. The silicles of *D. ogilviensis* are said to be "reticulate" and "larger than in *D. sibirica*". In the large material before me the silicles are perfectly smooth, or the valves may have a few short and stiff hairs near the distal end. At maturity they are lanceolate in outline and vary from 5 to 8 mm in length and 1.5 to 2.0 mm in breadth, which is in close agreement with measurement given for *D. sibirica* by Schultz (1957, p. 79) where the silicles are said to be 4-7.5 mm long and 1.5-1.8 mm wide and the styles 0.5 to 0.75 mm long. Busch (1913, p. 319) reported them 5-8 mm long and 1-2 mm wide, and Tolmatchev (1939, p. 446) described the silicles of *D. sibirica* as being oblong or narrowly lanceolate, glabrous, 4-8.5 mm long and distinctly shorter than the pedicels; the style is slender, 1 mm long (transl.).

When comparing specimens representative of the peculiarly discontinuous range of *D. sibirica*, from central east Greenland to Chukotsk Peninsula, exemplified by specimens in the National Herbarium of Canada from eastern Greenland [for example, Jameson Land, R. Marris, No. 2024; Montes uralenses polares Aug. 16, 1926, B. Gorodkov; Terra magna samojedorum, 68°N., 64°E., Aug. 4, 1958, O. Rebeistaya; Insl. Waigatsch, Aug. 17, 1926, H. Steffen; West Caucasus, Teberda, elev. 2600 m, July 1, 1963, K. Skvortsov; Schigalova ad fl. Lena, May 28, 1898, Nilsson-Ehle; Chukotsk Pen., and vicinity of Cape Chaplin, July 6, 1957, V. Gavriluk (distributed as *D. Eschscholtzii* Pohle)], a certain amount of variation is noted. Thus, in specimens from Caucasus, Ural and western Siberia the sessile 2- to 4-parted and truly malpighiaceous type of hairs

*This nicely fits the description of *Draba Gmelini* (*D. sibirica*) var. *caespitosa* (Pohle) Busch: *Caespitosa. Caudiculi abbreviati, dense foliosi, rosulati.*

so well illustrated by Gelert (l.c.) are predominant, whereas in specimens from eastern Siberia such hairs are rarely quite sessile and tend to be mixed with simple and variously forked hairs. Thus, Tolmatchev (l.c.) wrote "Differences between plants from different parts of the discontinuous range of *D. sibirica* provide insufficient basis for describing races or different kinds of micro-"species", thus plants from mountains in the Caucasus have been reported as *D. repens* M.B. and plants from other parts of the range of *D. sibirica* s. str. as *D. Gmelini Adams*" (transl.).

In conclusion it should be noted that the Ogilvie Mt. plant is a very close match for collections from Chukotsk Pen., Cape Chaplin, cited above under *D. sibirica.*

When visiting the Komarov Herbarium in Leningrad in 1957 I examined and photographed the specimens on which *D. Eschscholtzii* Pohle is based: (1) "ad sin. St. Laurent. Eschscholtz" and (2) "ad Fretum Seniavin Dr. Mertens." Both are from the Asiatic shore of Bering Strait; the first from near East Cape, the second from north of Cape Chaplin. Both had been annotated by R. Pohle as "*Draba Eschscholtzii* m. (= *D. affinis* Ledeb., *non Host.*)." The annotations were later initialed by N. B[usch].

D. Eschscholtzii is illustrated by Busch (l.c., p. 325) who, in a note below the figure, specifically stated that the drawing was made from the Eschscholtz collection which, inasmuch as none was designated, must be considered the type from which the description was based.

To me the Eschscholtz and Mertens plants suggest a closer affinity to *D. alpina* than to *D. sibirica*, whereas a third specimen, also in the Komarov Herbarium, from "Herb. Ledebour", and originally labelled "*Draba Gmelini* DC. – *affinis* mihi – e Sinu St. Laurentii", clearly is *D. sibirica* although it also was annotated "*D. Eschscholtzii*" by Pohle (and Busch). Tolmatchev's description of *D. Eschscholtzii* in Fl. USSR, Vol. VIII, is obviously, like that by Pohle, based on the Eschscholtz collection from "Sin. St. Laurent" and suggests that, in 1939 he had seen no other material of that "species". Therefore it is important to note that the illustration of *D. Eschscholtzii* in Fl. USSR, plate XXIV, bears no resemblance whatsoever to that given by Busch (noted by Tolmatchev as "*haud bene*") and that in his commentary on *D. Eschscholtzii* Tolmatchev (l.c.) wrote "This species is closely related to *D. alpina* or possibly *D. ochroleuca* Bge., but to include it with *D. sibirica* would be a mistake" (transl.).

Hultén (1945, p. 851) took up *D. Eschscholtzii* Pohle and cited two specimens from upper and central Yukon Territory, and one from the lower Yukon, Alaska, but stated that his concept of that species was based on the description and illustration of *D. Eschscholtzii* in Fl. USSR, and that he had seen no authentic material. The three specimens cited are all in the U.S. National Herbarium. Judging from the description given by Hultén (l.c.) they are not conspecific with the Ogilvie Mountain plant.

It seems clear, then, that *D. Eschscholtzii* Pohle is a *nomen confusum*, based in part on specimens related to *D. alpina* and perhaps partly on an eastern Siberian specimen of *D. sibirica.* At any rate, the two Gavriluk collections from Cape Chaplin clearly must be placed with *D. sibirica*, as must the Yukon

plant from the Ogilvie Mts. which I reported as *D. sibirica* for which Hultén needlessly proposed *D. ogilviensis*.

REFERENCES

BÖCHER, T. W. 1966. Experimental and cytological studies on plant species. Biol. Skrifter, Danske Vidensk. Selskab, 14,7.

BUSCH, N. 1913. Flora Sibiriae et Orientis Extremi (*Cruciferae.*).

GELERT, O. 1898. Notes on arctic plants. Botanisk Tidsskr. 21,3:288-318.

HULTÉN, E. 1945. Flora of Alaska and Yukon. Vol. 4. Lund.

———. 1966. New species of *Arenaria* and *Draba* from Alaska and Yukon. Botaniska Notiser, 119, 2:313-316.

PORSILD, A. E. 1964. *Potentilla stipularis* L. and *Draba sibirica* (Pall.) Thell., new to North America. The Canadian Field-Naturalist, 78,2:92-94.

SCHULZ, O. E. 1957 (reprint). Pflanzenreich, IV. 105, Heft 89.

TOLMATCHEV, A. N. 1939. (*Draba*) in Flora USSR Vol. VIII.

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SOME PARASITES RECOVERED FROM THE OCEAN SUNFISH, *MOLA MOLA* (L.), IN NEWFOUNDLAND

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INTRODUCTION

A LARGE, SLOW-MOVING, somewhat bizarre fish (Plate 1), often seen in Newfoundland waters, but rarely caught, is the Ocean sunfish, *Mola mola* (L.). This species of fish is usually heavily infected with both helminth and crustacean parasites, many papers having been written on the subject, some of the most recent being those of Price (1939, 1959), Noble and Noble (1937), and Dartevelle (1950). Three specimens of the sunfish obtained from Newfoundland waters were examined for the presence of parasites. This fish species has apparently not been examined for parasites in Canada.

MATERIALS AND METHODS

During the period August, 1965 to August, 1966 three sunfish were caught in the waters off the Avalon Peninsula, Newfoundland. Details of where, when and how the fish were obtained are given in Table 1, as are measurements and the weight of each fish. The external surface of the fishes was first of all examined for parasitic copepods and monogenetic trematodes, and then the entire host specimens were examined for helminth burdens. Any trematodes, cestodes or crustaceans found were fixed in 5 percent formalin and later stained, when necessary for identification, with Acid carmine. The parasites were identified using various works of Linton (1897, 1898, 1901a, 1901b, 1913, 1928, 1940) and Yamaguti (1958, 1959, 1963a, 1963b).

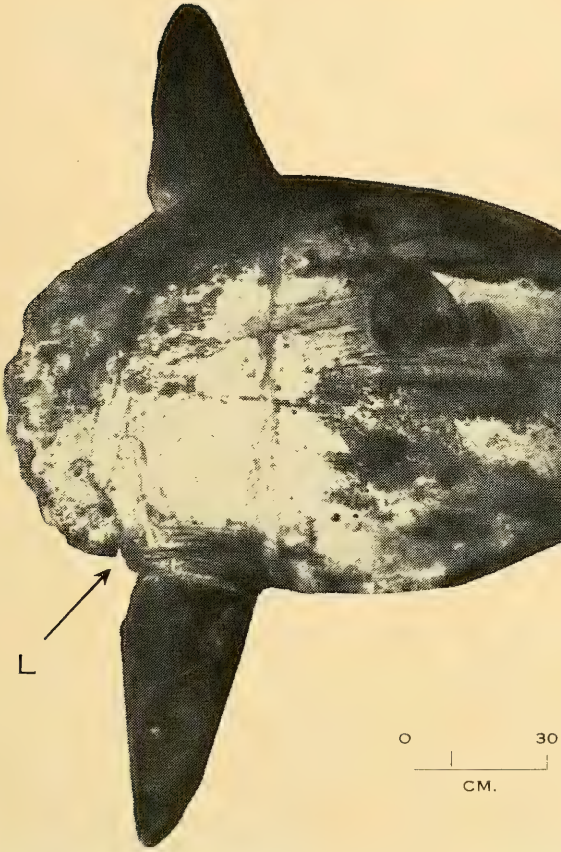

FIGURE 1. The Ocean Sunfish (*Mola mola*) No. 3. A large lesion may be seen just posterior to the anal fin.

RESULTS AND DISCUSSION

Table 2 lists the parasites identified, where they were located in or on the fish and in what quantities they were recovered. A total of 12 species of parasites were recovered from the three sunfish. Four species of parasitic copepods were found, two of which caused lesions on the body surface of the fishes, namely *Orthagoriscola wilsoni* (Schuurm-Stekhoven, 1956) and *Philorthagoriscus serratus* (Kroyer, 1863). *P. serratus* was found lying in small lesions 4.5-7.5 mm in diameter in the tail region of fish No. 3. In many cases all of the copepod visible was the long egg strings of the female. In all three sunfish examined a lesion was found behind the anal fin; in the case of specimen No. 3 the lesion was 105 x 45 mm in diameter, and contained a number of specimens of *P. serratus* lying deeply embedded in the subcutaneous tissues.

Five species of trematodes were found, including *Capsala martinierei* Bosc 1811, an ectoparasite which was generally found in greatest numbers in the region of the pectoral fin. When a specimen of this helminth was removed from the body surface of the fish the area of skin lying directly below the

TABLE 1.—Giving details of the Ocean Sunfish (*Mola mola*) examined in the present work.

	Specimen		
	1	2	3
Date obtained	August, 1965	July, 1966	August, 1966
Where	Fermeuse	Long Pond	Conception Bay
How	Cod Trap	Jigged	Rod and Line
Weight (lbs.)	230	120	338
Length (cm.)	110.0	91.5	138.0
Depth (cm.)	145.0	119.5	175.0

trematode seemed to be lighter in colour than the rest of the surrounding skin and was not covered by mucus. It is possible that the helminth secretes a substance that dissolves the host mucus and thus allows a better contact between trematode and host.

Several papers have been written concerning the digenetic trematodes of sunfish, a total of one species of the genus *Accacoelium* Monticelli 1893, two species of *Accacladium* Odhner 1928, and four species of *Accacladocoelium* Odhner 1928, having been described from this species of fish by Linton (1898; 1901b; 1913; 1940), Noble and Noble (1937), Odhner (1928) and Robinson (1934). *Distomum fragile* was described by Linton (1901b) and no further records of this helminth were found in the literature.

One species of cestode which matures in the sunfish, *Ancistrocephalus microcephalus* (Rudolphi, 1819), was found, in addition to two types of larval cestodes, *Tetrarhynchus elongatus* Wagener, 1901 and *Rhynchobothrium sp.* Linton, 1899. *T. elongatus* was found with its anterior end lying immediately below the serous coat of the liver whereas the posterior region lay deeply embedded in the liver tissue, as described by Linton (1901b). A single specimen of *Rhynchobothrium sp.* was found in a cyst, measuring approximately 7 x 5 mm, which was embedded in the serous coat of the intestine wall. It can also be seen (Table 2) that specimen No. 3, the largest fish examined, was rather more heavily infested with parasites than either specimen 1 or 2.

The alimentary tract of all three specimens was filled with a thick creamy white, chyme-like substance that contained copious amounts of mucus. In specimen No. 1 a few small pinkish amphipods were found (*Hyperia galba, Parathemisto gauchicaudi*), whereas in specimen No. 3 a few small medusae were observed. As ctenophores, coelenterates and amphipods seem to form a large part of the diet of sunfish it seems quite reasonable to suspect that some of these organisms may act as intermediate hosts for the parasites found.

ACKNOWLEDGEMENTS

I would like to thank the people who supplied me with the sunfish and I would also like to thank Dr. D. H. Steele who very kindly identified the amphipods for me.

TABLE 2.—Giving details of the parasites found in three Ocean Sunfish, *Mola mola* (L.), taken in Newfoundland waters.

Parasite	Specimen 1	Specimen 2	Specimen 3	Position
Copepoda				
Philorthagoriscus serratus (Kroyer, 1863)	–	–	15	Body surface
Orthagoriscola wilsoni (Schuurm-Stekhoven, 1956)	7	3	–	Body surface
Cecrops latreillii Leach, 1816	15	–	22	Gills
Lepeophtheirus nordmanni Milne Edwards, 1840	–	29	–	Body surface
Trematoda (a) Monogenea				
Capsala martinierei Bosc, 1811	8	11	79+	Body surface
(b) Digenea				
Accacoelium contortum (Rudolphi, 1819)	–	–	11	Pharynx
Accacladium nematulum Noble and Noble, 1937	26	3	–	Intestine
Accacladocoelium macrocotyle (Diesing, 1858)	17	6	20	Intestine
Distomum fragile Linton, 1900	4	1	13	Intestine
Cestoda				
Ancistrocephalus microcephalus (Rudolphi, 1819)	120	141	202	Intestine
Tetrarhynchus elongatus Wagener, 1901		Numerous		Liver
Rhynchobothrium sp. Linton, 1899	–	–	1	Intestine wall

REFERENCES

DARTEVELLE, E. 1950. Un "Sunfish" *Mola mola* (Linne), a Banane. Zooleo, Leopoldville, N.S., 8: 35-40.

LINTON, E. 1897. Notes on larval cestode parasites. Proceedings of the United States National Museum. 19: 423-456.

———. 1898. Notes on trematode parasites of fishes. Proceedings of the United States National Museum. 20: 507-548.

———. 1901a. Fish parasites collected at Woods Hole in 1898. Bulletin of the United States Fisheries Commission. (1899) 19: 267-304.

———. 1901b. Parasites of fishes of the Woods Hole region. Bulletin of the United States Fisheries Commission. (1899) 19: 405-492.

———. 1913. Cestoda, In Summer, Osburn and Cole. Catalogue of marine fauna of Woods Hole and vicinity. Bulletin of the United States Bureau of Fisheries. (1911) 31: 763.

———. 1928. Larval cestode (*Tetrarhynchus elongatus* Rudolphi) from the liver of the pelagic Sunfish (*Mola mola*) collected at Woods Hole, Massachusetts. Transactions of the American Microscopical Society. 47: 464-467.

———, 1940. Trematodes from fishes mainly from the Woods Hole region, Massachusetts. Proceedings of the United States National Museum. 88: 1-172.

NOBLE, A. E. & G. A. NOBLE. 1937. *Accacladium nematulum* n. sp. a trematode from the sunfish, *Mola mola*. Transactions of the Americal Microscopical Society. 56: 55-60.

ODHNER, T. 1928. *Rhynchopharynx paradoxa* n.g. n. sp. nebst Revision der Accacoeliiden von *Orthagoriscola mola*. Zoologischer Anzeiger. 77: 167-175.

PRICE, E. W. 1939. North American Monogenetic Trematodes. 111 The family Capsalidae (Capsaloidea). Journal of the Washington Academy of Science. 29: 63-92.

———. 1959. What is *Capsala martinierei* Bosc? All India Congress of Zoology. Abstracts of Papers 1: 40.

ROBINSON, V. S. 1934. A new species of Accacoelid termatode (*Accacladocoelium alveolatum* n. sp.) from the intestine of a Sunfish (*Orthagoriscus mola* Bloch.). Parasitology. 26: 346-351.

YAMAGUTI, S. 1958. Systema Helminthum. Volume 1. Digenetic Trematodes. Parts 1

& 2. 1575pp. Interscience Publishers. New York and London.
———, 1959. System Helminthum. Volume 11. Cestodes. 860pp. Interscience Publishers. New York and London.
———, 1963a. Systema Helminthum Volume IV. Monogenea and Aspidocotylea. 699pp. Interscience Publishers. New York and London.
———. 1963b. Parasitic Copepoda and Branchiura of Fishes. 1104 pp. Inter-science Publishers. New York and London.

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THE PASSENGER PIGEON IN WELLINGTON COUNTY, ONTARIO

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AS A BOY MY LIFE was active and wholesome, with a love for outdoor pastimes which took me into the fields and woods whenever the opportunity presented itself. From which side of the genealogical tree this ardor for field and forest and open sky had come with stronger influence, I cannot say, but at any rate it was my good fortune to attend elementary school at the Macdonald Consolidated on the campus of the Ontario Agricultural College (now University of Guelph). There we were blessed with teachers who had a dedicated interest in nature. They frequently invited Professor Crow of the Ontario Agricultural College to come over to our classes and give talks about birds, especially the Passenger Pigeon, *Ectopistes migratorius*.

This experience was followed by a visit with our teachers to the old museum in the biology building on the College campus to see the three mounted specimens of this famous bird which were on display. This created in me a desire to learn more about this extinct species from several of the old timers in our midst who well remembered the pigeon when they were boys, and the following paragraphs are the fruits of this material which I had carefully preserved in mind and note.

NESTING ROOKERIES

The last known nesting site in this area was Hatch's Swamp, 1855, where the Collegiate Institute now stands and stretching a mile or more northward, but older inhabitants related that old timers before them told of an immense rookery in 1835 which extended on both sides of the river from Guelph to Rockwood; within its bounds trees were broken down by the weight of the birds.

OBSERVATIONS

Mr. Strickland Duffield, a member of a well known family who farmed in the Township of Eramosa, collected two male pigeons at Rockwood in 1875. These specimens are now in the Royal Ontario Museum under catalogue No. 67103 and No. 67104 and the writer quite recently had a conversation with Mr. Duffield's daughter, who lives in the Guelph district, and she said that her late father recalled the days when the pigeons were very numerous and flew in great flocks, but they disappeared from this area before 1890.

Mr. Fred Fennell of Guelph has told me many times that his father as a boy lived in what is now Riverside Park, in the 1870s, and he often related how the pigeons lighted in the hardwood trees of that area in great numbers and that his father before him recalled huge flocks feeding on the beech nuts in that forest which stretched along the river.

North of Guelph is a small settlement known as Marden, and here lived the Blyths, early pioneers of that area, and their land had a stream flowing through it and hardwoods and bush on either side and they told how they shot the pigeons in great numbers in the hardwood and bush, and their story was that if the swamp there could be drained, you would be able to collect a ton of shot that was expended at the pigeons. This of course is just a story but it helps to prove that the pigeons were in great numbers there at the time, in the 1860s. Mrs. Charles Blyth said that her father, Mr. Charles Atkinson, used to bring pigeons home by the sackful from that bush.

My father related that as a boy he used to lie on the bank near their old home, where the railway track now runs back of the old Sleeman mansion on Waterloo Avenue, and watch the pigeons fly across the gully to the hardwoods on the hillside near where the Lime Kilns are now situated. This would be in the late 1870's but he definitely stated that at that time there were no large flocks and only small ones remained and after a short time they disappeared altogether. He said also that after school on Friday he would walk to his Aunt and Uncle's farm (Mr. and Mrs. John Mack) on the Erin and Eramosa town-line and he used to see pigeons in small numbers in the hardwood near his uncle's farm, especially in the early spring.

Dr. Henry Howitt reported that the last pigeon he saw alive was a lone female in a tree along the Speed River opposite where the Reformatory now stands, in July 1881; and a female pigeon which was in the Peterson Estate in Guelph and later owned by the late Thomas Bedford who in turn gave the bird to Dr. Byerly of Guelph, a local historian, who saw to it that it reached the Royal Ontario Museum (catalogue No. 67154), shows that it was collected in the early 1880s in Eramosa, which is in the same general area as the Howitt bird and this perhaps could be the same lone female. He also said that in the 1850s the pigeons were in large numbers in this area and he recalled the difficulty his father had with the spring planting of grain at that time on their farm near where the lime kilns are now situated. This is the same general area where my father spent his boyhood but as I stated before, in my father's time the large flocks had disappeared.

Dr. Howitt also recalled that one day in June in 1856 he was walking through the primeval woods of Well's Island opposite the old Red Mill where now stand the bus barns of the local transportation system. He there found a wild pigeon's nest and took from it a downy squab which he took home and raised. He said also that the pigeons from Hatch's Rookery flew for feeding to the higher ground near his home but after the end of the rookery, only lone pairs nested along the Speed River in the direction of the now Ontario Reformatory. In the early 1880's Dr. Howitt collected four pigeons, which are now in the Buffalo Museum of Science.

The late Jack Smith of Guelph who was the eldest of a family of noted hunters and trappers, stated that as a boy he and his brother Joe, next to him in age, and his father shot pigeons in Heming's Bush in the late 1870s, which is in close proximity to what is now the main part of the city of Guelph.

Henry Rydall, brother-in-law of William Holliday, the master taxidermist of Guelph, recalled that he and Benjamin Hillen shot a lone pigeon in Heming's Bush in the 1860's when they were young and that it was the last of that species that he ever saw. It proved to be a large male bird. They skinned it and attempted stuffing the specimen but he could not remember what became of it. This incident again shows that the pigeons in this area had almost disappeared by the 1880's.

Mr. Robert Pasmore, Rockwood, stated that the Pigeons at one time were quite numerous in that area, but the last bird he saw was in the spring of 1884.

Mr. David Young of Guelph, a well known builder, spent his early boyhood in the township of Puslinch and he remembered the days when they were still clearing the primeval forest of red pine and rolling back the stumps to form the fences, which made natural resting places for the pigeons while they were feeding on the grain in the cleared areas. He knew of a settler who kept a heavy gauge shotgun loaded at all times in the granary of the old log barn and he remembered full well a flock of pigeons fly up from the field and light on the fence row. The farmer lined up this heavy gun and fired and the slaughter was tremendous. This period was in the early 1860's. Mr. Young also stated that the last pigeons he saw was a small flock of about a dozen which flew over the village of Arthur, north of the city of Guelph, about 1890.

SPECIMENS IN LOCAL COLLECTIONS

As stated earlier, I became extremely interested in the wild pigeon and wherever there were any birds in local collections, I endeavoured to see them or enquire about them. My observations are as follows: A male, owned by taxidermist Wm. Holliday, which was later sold to a British Museum; a female in the Peterson Estate, now under catalogue No. 67154 in the Royal Ontario Museum; two males collected by Mr. Strickland Duffield now No. 67103 and No. 67104 in the Royal Ontario Museum. Dr. Henry Howitt had three males and one female which for many years were in the Hall Estate at Guelph and are now in the Buffalo Museum of Science; two male birds that I obtained from old collections and the three males in the Ontario Agricultural College collection that at my suggestion were transferred to the Royal Ontario Museum (R.O.M. Nos. 94388, 94346, 94347, 94348 and 94349, along with a male specimen which I secured for the Museum from Mr. Edwin Dixon of Richmond Hill and which was under control of his nephew, Mr. Fred Dixon of Guelph, local member of City Council. This is No. 94645 and is considered to be one of the finest in the Museum collection.

It was my privilege as a boy to know the gentlemen referred to in this bulletin and it was indeed interesting to hear them relate their stories of the Passenger Pigeons in the vanished days of their youth.

Accepted March 31, 1967

BIRD POPULATIONS IN FIELDS OF ONTARIO COUNTY, 1965

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This is the first of a series of studies of bird populations in Ontario County. Fields were chosen for first attention since they comprise the major part of the area of the county. There are about a half million acres of land in Ontario County, of which in 1950 somewhat more than half (53%) were in fields of various kinds (Olding, Wicklund and Richards, 1956). Ontario County runs north from Lake Ontario to Muskoka. On the east are Durham County and Victoria County. Scugog Island is included in the county. To the west are York County and Simcoe County, Lake Simcoe and Lake Couchiching. The Lake Ontario shore is about 275 feet above sea level. Lake Simcoe and Lake Couchiching have surface levels at about 750 feet. The interlobate moraine in Uxbridge Township rises to elevations above 1300 feet. There are numerous drumlin hills both north and south of the interlobate moraine.

Description of Fields Censused

1. Pickering Township: The plot in this township was chosen to represent fields near the Lake Ontario shore. This was an old field habitat with grasses (*Poa* and others), asters and goldenrods (*Solidago*) the chief cover plants, with some encroachment by raspberry (*Rubus*), dogwood (*Cornus*) and other shrubs. The highest point, in the center of the plot, held a few big Norway spruces (*Picea abies*), lilacs (*Syringa*) and apple trees (*Pyrus*). Both the entire 40-acre plot and a 27.2-acre outer ring were censused. Ten censuses were carried out on this plot between May 24 and July 1, 1965 by Rev. Charles Long, Kenneth Adcoe and the authors.
2. Whitby Township: The plot in this township was chosen to represent farm fields midway between Lake Ontario and the interlobate moraine. The western and much of the southern border of the plot was fairly heavily pastured by cattle while the eastern border was lightly grazed by a few sheep. Electric fencing excluded the livestock from a northern border of corn and oat crops. The plot sloped gently from north to south. Two censuses were conducted by the authors, on the evening of June 14 and the morning of June 15, 1965.
3. East Whitby Township: This plot was a hayfield on the hilly, sandy interlobate moraine. It is near the height of land and slopes off to Lake Scugog to the north and Lake Ontario to the south. The whole field was in clover-alfalfa-timothy hay, with a good deal of mullein (*Verbascum*) and other weeds in the low area near the west border. Some sumac (*Rhus typhina*) and cherry (*Prunus pensylvanica*) were

TABLE 1.—Bird populations (Territories) on the outer 27.2 acres of the Pickering Township plot in 1965

Date	5–24	5–30	6–5	6–8	6–9	6–14	6–15	6–22	6–24	7–1	Season
Savannah Sparrow	15	10	9	8	12	9	16	13	10	11	14½
Bobolink	5	5	3	3	3	3	7	4	5	9	9¼
Redwinged Blackbird	1	3	4	7	2	4	5	6	4	6	7¼
Song Sparrow	4	3	6	4	3	3	7	4	2	3	6¾
Eastern Meadowlark	1	3	1	3	2	2	1	1	2	1	2
Robin	1	–	2	2	1	–	1	1	–	1	1
Killdeer	–	1	–	–	1	–	1	1	1	1	¾
Yellow-shafted Flicker	1	–	–	–	–	2	–	1	–	1	¾
Henslow's Sparrow	–	–	–	1	–	–	–	–	1	–	½
Total Territories	28	25	25	28	24	23	38	31	25	33	42¾
Efficiency %	66	59	59	66	56	54	89	72	59	77	100

Individual censuses averaged 66% efficient in estimating the whole population on the plot: variation 54% to 89%.

invading the southern edge. Eight censuses were carried out between May 27 and June 30, by J. M. Richards and the authors.

4. Uxbridge Township: This was a very hilly hayfield, with an abrupt dropoff along the southern edge where a few large beech (*Fagus grandifolia*), birch (*Betula papyrifera*) and hawthorn (*Crataegus*) grew. A 1.6 – acre stand of pines about 10 feet tall grew on the western edge and a gravel pit occupied somewhat less than an acre on the northern edge. A deserted dwelling and barn occurred near the pine plantation. Two censuses were carried out by the authors, on the evening of June 21 and the morning of June 22, 1965.
5. Reach Township: This was a pasture field with a strong slope from southeast to northwest. A small creek ran along its west border. The field was heavily grazed by cattle. Rows of piled stones and trees indicated former fence lines and trees grew along the present field borders. The trees included elms (*Ulmus*), choke cherry (*Prunus virginiana*), yellow birch (*Betula lutea*) and hop hornbeam (*Ostrya virginiana*). Wet patches along the western edge had some dwarf willow and some sedge. The plot was censused by the authors on the evening of June 16 and morning of June 17, 1965.
6. Scugog Township: This was a mixed farming type of plot with 16.3 acres in hay on the western side of the plot, 7.0 acres in corn and 2.3 acres in oats on the western side with a farm road separating the two sides. A drainage ditch ran across the northwest corner. The authors made two censuses on this plot, on the evening of June 10 and the morning of June 11.

TABLE 2.—Comparison of two census method with ten census method on Pickering Township plot in 1965

	June 8 & 9	June 14 & 15	Season
Savannah Sparrow	14	16	14½
Bobolink	5	9	9¼
Redwinged Blackbird	7	7	7¼
Song Sparrow	6	7	6¾
Eastern Meadowlark	4	2	2
Robin	2	1	1
Killdeer	1	1	¾
Yellow-shafted Flicker	–	2	¾
Henslow's Sparrow	1	–	½
Total Territories	40	45	42¾
Efficiency %	93	105	100

Two consecutive censuses, one in the morning and one in the evening, gave population estimates very nearly the same as ten censuses spread out over the breeding season.

7. Scott Township: This plot was sandy and hilly and heavily pastured. A woodlot of birch, elm and white cedar (*Thuja occidentalis*) occupied part of the center of the field (very little on the part actually censused) and a pine plantation bordered the plot to the southeast. A dirt road formed the southern edge of the plot. This was censused by the authors on the evening of June 28 and the morning of June 29, 1965.
8. Brock Township: This pasture field sloped gently from south to north. There were a few small white cedars in the southwest corner, the ruins of a barn foundation and a small waterhole east of these. The northwest corner of the field was separated by a row of piled stones with choke cherry shrubs and grape vines indicating the whereabouts of a former fence line. This plot was censused on the evening of June 23 and the morning of June 24, 1965 by the authors.
9. Thorah Township: This was a flat field with a stream meandering through it and a variety of crops, including 14.0 acres in hay, 3.4 acres in pasture and 8.2 acres in sorghum and some bare fallow land. Apple, willow (*Salix*) and ash (*Fraxinus*) bordered the stream. Censuses were made on the evening of June 29 and morning of June 30 by the authors.
10. Mara Township: This plot was a rocky pasture with wet sedge patches with chimneys of burrowing crayfish. A low ridge of limestone outcrop crossed the plot. There were two small waterholes for the cattle and a loading corral next to the road at the west boundary of the plot. This plot was censused on the evening of June 24 and the morning of June 25, 1965 by the authors.
11. Rama Township: Much of the eastern edge (8.1 acres) was in timothy hay separated by electric fencing from the remainder (17.5 acres) which made up part of a large pasture on which 14 cattle and four horses grazed. A ditch with sedge crossed the pasture. This plot

was censused on the evening of June 17 and the morning of June 18 by the authors. A red fox was surprised as it made its way across the field on the evening of June 17.

CENSUS METHOD

As described above, eleven fields were chosen for study during the summer of 1965, one in each of the eleven townships of the county. In each case a forty acre field was selected. In the case of the Pickering and East Whitby plots the whole forty acres were censused on a number of occasions with the aid of volunteer assistants. In the other nine plots only a strip four chains wide around the outside of the plots was censused so that an area of about 25 acres was covered. For comparison of methods this technique was also used by the authors on the Pickering and East Whitby plots.

The fields were surveyed using steel tape (two chains long — 132 feet) and compass. A cedar stake (2″ x 1″ x 3 ft. sharpened at one end) was driven into the fields at four chain intervals around the perimeter, with a parallel row inside this four chains distant. This called for 20 stakes in the outer ring and 12 in the inner ring. These were numbered consecutively. A quadrille notebook was carried with an outline plan of the plot showing the position of the stakes on it and any features of special interest on the plot. The positions of all birds identified on the four chain wide outer ring of the plot were marked on the map as the grid was being laid out (usually during an afternoon), again in the evening (usually immediately following the survey layout) and again the following morning, after which the stakes were retrieved for use on another plot. Yellow flagging tape was attached to the top of the stakes to help in locating them. On hay and crop fields this was a definite advantage but in pasture fields it often attracted the curious attentions of the cattle or horses that often proceeded to eat the tape or knock over the stakes. In the Pickering and East Whitby fields the whole forty acre plot was staked out at four chain intervals.

COMPARISON OF CENSUS METHODS

(a) On the Pickering Township Plot:

Ten census counts were made covering the complete forty acre field between May 24 and July 1, 1965 by Rev. Charles Long, Kenneth Adcoe, and the authors. Table 1 presents the results for the outer ring four chains wide. Since this was a rectangular field the area of the outer ring in this case was 27.2 acres (rather than 25.6 acres as in the square fields). The data in table 1 has been obtained from composite maps, one drawn up for each species found on the field during the census period. For the individual censuses a territory was considered to be occupied if either member of the pair was noted on the outer ring during the count. The fractions in the "Season" column result from territories which extended outside or inside this outer ring. From table 1 it will be seen that the individual censuses averaged 66% efficient for the whole population of the outer ring, varying from 54% to 89% efficient. Table 2 compares the season total as determined from the whole 10 censuses with estimates based on two consecutive censuses, one morning and one evening. From this

TABLE 3.—Bird populations (territories) on the outer 25.6 acres of the East Whitby plot in 1965

Date	May 27	May 31 a.m.	May 31 p.m.	June 7	June 22	June 30	Season
Savannah Sparrow	6	10	5	10	16	12	14
Grasshopper Sparrow	6	7	8	8	9	9	10½
Bobolink	3	3	4	2	3	1	3¼
Henslow's Sparrow	3	1	2	–	2	2	2½
Vesper Sparrow	2	2	2	1	1	1	2
Eastern Meadowlark	1	2	1	2	1	1	1¾
Song Sparrow	2	1	1	2	3	2	1½
Total Territories	23	26	23	25	35	28	35½
Efficiency %	65	73	65	70	99	79	100

Individual censuses averaged 76% efficient in estimating the whole population on the plot: variation 65% to 99%.

it will be seen that the June 8-9 combination gave a 93% while the June 14-15 combination gave a 105% estimate of the value established by the 10 censuses spread out over the breeding season.

(b) On the East Whitby Township Plot:

Six census counts were made covering the complete forty acre field between May 27 and June 30, 1965 by J. M. Richards and the authors. Table 3 presents the results for the outer four chain ring. For this plot the individual censuses averaged 76% efficient as compared with the season total, varying from 65% on the poorest days to 99% on the best day. Table 4 compares the results of two consecutive censuses on the morning and evening of May 31 with the population estimated after the six censuses covering the whole season. The results here were very similar; the two-census method giving 102% of the whole season estimate.

COMPARISON OF BIRD POPULATIONS ON THE ELEVEN PLOTS

In table 5 the numbers of each species found are compared on the basis of number of birds (not territories) per 100 acres. The birds are listed in order of total abundance on all eleven plots. The actual acreage censused was 25.6 acres per plot except for the Pickering Township plot where the rectangular shape resulted in an outer ring of 27.2 acres. All the other plots were square (20 chains by 20 chains). The Pickering plot was 16 by 25 chains, still 40 acres.

Fourteen of the thirty species found on the eleven census plots might be considered true field birds, obtaining both food and nesting shelter in the fields. The other sixteen species obtained food from the fields but nested in trees or buildings.

The Savannah Sparrow was found to be by far the most abundant breeding bird in the fields of Ontario County. This species made up about a third of the total population of field birds and was three to four times as abundant as the Bobolink, the next most common species. It occurred on ten of the eleven fields censused and was the most abundant bird on all ten of these. It was not

found on the field in Scott Township but could be heard singing from nearby fields in this township. If these eleven fields may be considered representative of fields in the county, then the total population of this species in Ontario should be of the order of 200,000 breeding birds (290,000 acres in fields x 71.3 Savannah Sparrows per 100 acres). Populations in old fields and hayfields averaged about one bird of this species per acre while in pasture fields they were about half as common.

Bobolinks were found in nine of the eleven fields censused and ranked second in overall abundance. They showed a strong preference for old fields and hay fields with relatively small numbers in pastures.

Eastern Meadowlarks were the most frequent species, being found in all eleven plots but they ranked third in overall abundance. On a biomass basis they no doubt exceed the Bobolink in importance and approach the Savannah Sparrow. Their numbers varied little from 15 per 100 acres, regardless of the townships or the type of field.

Song Sparrows ranked fourth in overall abundance, but showed a strong preference for the old field habitat, with very few in pastures.

Grasshopper Sparrows were quite numerous on the sandy fields with dead mullein stalks which they used for singing perches, in East Whitby and Uxbridge townships. In this habitat they approached the abundance of Savannah Sparrows. This species occurred sparingly throughout the rest of the county but was not found on any of the other plots censused though they could be heard singing from the Scugog and Scott plots.

Vesper Sparrows were found on more than half of the plots, being the most abundant species on the Scott Township plot and quite numerous on all the high, dry fields in the mid portion of the county. They were relatively scarce in the extreme northern and southern townships.

Redwinged Blackbirds are spilling over from their preferred habitat in cattail (*Typha*) marshes and are breeding in many fields in the county. They ranked third in abundance in the old field plot in Pickering Township where they were nesting in clumps of goldenrod (*Solidago*).

Three "shorebirds" are found in the fields of Ontario County in summer. The Killdeer is the most numerous of these, breeding in bare gravelly patches and feeding in ploughed fields or pastures. The Upland Plover was found in three of the eleven census plots. It is partial to lightly grazed pastures. The Spotted Sandpiper prefers ploughed fields near a creek and was found in this habitat in Thorah Township plot.

The Horned Lark was the most characteristic bird of recently cultivated fields where corn or oats had been planted, or on bare areas of other types of field.

Henslow's Sparrows were found on four of the plots censused. It is difficult to accurately census this secretive species as can be seen from Table 3 where the species was missed entirely on one census whereas several were heard on previous and following censuses. This species appears to favour old fields and hay fields with clover or alfalfa. The numbers found would suggest that it may be much more abundant than is generally supposed.

TABLE 4.—Comparison of two census method with whole season method on East Whitby Township plot in 1965

	May 31 a.m. and p.m.	Season
Savannah Sparrow	13	14
Grasshopper Sparrow	11	10½
Bobolink	5	3¼
Henslow's Sparrow	2	2½
Vesper Sparrow	3	2
Eastern Meadowlark	2	1¾
Song Sparrow	1	1½
Total Territories	37	35½
Efficiency %	102	100

Two consecutive censuses, one in the morning and one in the evening, gave population estimates very nearly the same as the six censuses spread out over the breeding season.

The only hawk breeding in the fields of Ontario County is the Marsh Hawk, which was found in the Uxbridge plot and was frequently seen over the Pickering and East Whitby plots.

The Yellow Throat was the only warbler found on any of the plots during the breeding season.

The other sixteen species listed in Table 5 affect the economy of the fields to a minor extent, feeding to some extent on the fields but not breeding there. They made up about eleven per cent of the birds on fields censused in 1965. The icterids and Starling may be very abundant locally, particularly in mid and late summer, when they can affect not only the wildlife economy but the human economy also. None of these large, post-breeding flocks occurred on the fields actually censused in 1965 though some were seen on neighbouring fields.

The total population of field birds in Ontario County should be of the order of a half million birds (290,000 acres x 194 birds per 100 acres). The six most abundant species made up three quarters of the total population in the summer of 1965.

DISCUSSION

The hollow square census technique followed in our field studies in 1965 was suggested by the work of Merikallio (1958) in Finland and of Karvik (1964) in Sweden. Graber and Graber (1963) also used this technique in their studies of bird populations in Illinois.

The hollow square has the advantage of other strip census methods, in that two observers can walk on either side of the strip and record the birds noted between them. It has the great practical advantage over the old linear strip technique in that the census ends where it begins (near the vehicle which gets the observers to the census area). Our census technique differs from the others mentioned in that the plots were staked out in advance. In open fields the additional time taken to stake out the census areas is not a major consideration and actually many individuals were located during the process of laying out the plots. Both Merikallio and Karvik worked in forests in which they found it expedient to estimate the width of their census strips. A good portable electronic

TABLE 5.—Numbers of birds per 100 acres on sample plots in Townships of Ontario County in 1965

Township	Pickering	Whitby	East Whitby	Uxbridge	Reach	Scugog	Scott	Brock	Thorah	Mara	Rama	Total	Average
Savannah Sparrow	106	57	109	74	74	94	–	47	59	80	84	784	71.3
Bobolink	68	41	25	4	8	35	–	10	–	4	16	211	19.2
Eastern Meadowlark	15	24	14	16	12	8	8	14	22	20	12	165	15.0
Song Sparrow	50	–	12	49	20	8	–	–	16	x	2	157	14.3
Grasshopper Sparrow	–	–	82	55	–	–	–	–	–	–	–	137	12.5
Vesper Sparrow	x	–	16	39	8	10	51	–	10	–	–	134	12.2
Redwinged Blackbird	53	16	–	x	x	8	–	10	x	–	–	87	7.9
Killdeer	6	x	x	–	12	8	–	16	16	8	8	74	6.7
Horned Lark	x	6	x	–	4	29	2	–	24	–	4	69	6.3
Robin*	7	4	–	8	20	–	6	4	6	4	–	59	5.4
Henslow's Sparrow	4	–	20	4	–	16	–	–	–	–	–	44	4.0
Eastern Kingbird*	x	–	x	10	4	–	x	–	6	4	–	24	2.2
Yellow-shafted Flicker*	6	–	x	4	x	–	6	x	–	6	–	22	2.0
Chipping Sparrow*	–	–	x	16	–	–	6	–	–	–	–	22	2.0
Upland Plover	–	10	–	–	–	–	–	–	8	4	–	22	2.0
American Goldfinch*	x	8	x	x	2	4	x	x	x	4	x	18	1.6
Barn Swallow*	x	–	x	16	–	x	–	–	–	–	–	16	1.5
Starling*	x	8	x	x	x	–	x	x	4	–	x	12	1.1
Eastern Bluebird*	–	–	–	4	–	–	4	–	4	–	–	12	1.1
Brown Thrasher*	–	8	–	–	–	–	2	–	–	–	–	10	0.9
Indigo Bunting*	–	–	x	10	–	–	–	–	–	–	–	10	0.9
Eastern Phoebe*	–	–	–	8	–	–	–	–	2	–	–	10	0.9
Crested Flycatcher*	–	–	x	8	–	–	–	–	–	–	–	8	0.7
Marsh Hawk	x	–	x	4	–	–	–	–	–	–	–	4	0.4
Spotted Sandpiper	–	–	–	–	–	–	–	–	4	–	–	4	0.4
Cedar Waxwing*	x	–	–	–	–	–	4	–	–	–	–	4	0.4
Yellowthroat	–	–	–	4	–	–	–	–	–	–	–	4	0.4
Brown-headed Cowbird*	x	x	x	x	x	4	x	x	x	–	–	4	0.4
Mourning Dove*	–	–	–	–	–	–	2	–	–	–	–	2	0.2
Common Grackle*	x	–	–	x	x	–	2	x	–	–	–	2	0.2
Total	315	182	278	333	164	224	93	101	181	134	126	2131	194

x seen on field but no territory evident
* use field for feeding, not nesting.

gadget for telling how far one partner is from another would be a big help in such censuses. Karvik (1964) gives a good review of the problems involved in censusing birds and some of the results published to date.

Our experience in 1965 suggests that a single strip census in field habitats is not more than about $\frac{2}{3}$ efficient, while two censuses – one made in the evening and one the morning before or after appears to be very nearly as efficient as a long-term study covering the whole breeding season. Graber and Graber (1963) also found strip censuses (number unspecified) to be nearly as efficient as a quadrat census in field habitats. We do not believe that two censuses would be adequate in forest habitats in which the observer depends almost entirely on vocal evidence for locating his birds.

SUMMARY

Breeding bird censuses were made on eleven fields, one in each township of Ontario County, during the summer of 1965. A hollow square strip census method was used, with a measured strip four chains wide surrounding 40 acre fields, to give a census area of a little over 25 acres on each of the eleven fields. The total bird population on the 290,000 acres of fields in Ontario County has been estimated to be about half a million birds (560,000) of which about 200,000 should be Savannah Sparrows. This species, with Bobolinks, Eastern Meadowlarks, Song Sparrows, Grasshopper Sparrows and Vesper Sparrows made up about 75% of the total bird population on the fields censused in 1965. Tables are presented listing these and other less common species in order of abundance.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the support of this study by the Canadian National Sportsmens' Show. The co-operation of the landowners on whose fields the counts were made is greatly appreciated. The quadrat studies in the Pickering Township plot (at Ajax) were largely carried out by Kenneth Adcoe and the Rev. Charles Long. James M. Richards assisted with the censusing on the East Whitby plot. The Department of Zoology, University of Toronto helped with survey equipment. The senior author's wife Doris gave encouragement throughout the project.

REFERENCES

GRABER, R. R. and J. W. GRABER. 1963. A comparative study of bird populations in Illlinois, 1906-1909 and 1956-1958. Bulletin of the Illinois Natural History Survey, 28: Article 3: 383-528.

KARVIK, N. 1964. The terrestrial vertebrates of Dalsland in southwestern Sweden. Acta Vertebratica, 3: (1): 1-239.

MERIKALLIO, E. 1958. Finnish birds. Their distribution and numbers. Fauna Fennica 5: 1-181.

OLDING, A. B., R. E. WICKLUND and N. R. RICHARDS. 1956. Soil survey of Ontario County. Ontario Soil Survey, Report No. 23: 1-60. Map.

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THE OCCURRENCE OF THE PEARLSIDES, *MAUROLICUS MUELLERI* (GMELIN), IN THE NORTHWESTERN ATLANTIC

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The pearlsides is abundant in the eastern and central Atlantic (Grey 1964) but has not previously been reported from farther east than the western Gulf of Maine in the northwestern Atlantic (Table 1, Figure 1). However, in 1959 several specimens were found in fish stomachs collected on the edge of the Scotian Shelf by the M.V. 'Harengus' of the Fisheries Research Board of Canada. A number of specimens were subsequently found in pollock stomachs collected off western Nova Scotia as well as in the Grand Manan region (Table 2, Figure 1, Steele 1963 as *M. pennanti*).

These collections show the pearlsides to be distributed west and south of Nova Scotia and also suggest that it is probably more abundant in the northwestern Atlantic than the few early records indicate.

The specimens listed in Table 2 that were examined were all immature and judging from their size, the previously reported specimens were probably also immature, since according to Grey (1964) maturity is not reached until a length of 50-60 mm. in this species.

Table 1.—Previous Captures of *Maurolicus muelleri* in the northwestern Atlantic*

Location	Lat.	Long.	Date	Source	No.	Size mm.	Reference
Nahant, Mass.	42°25′	70°55′	–/12/1837	beach	1		Storer 1839
Provincetown, Mass.	42°04′	70°11′		cod	1		Storer 1867
Provincetown, Mass.	42°04′	70°11′	–/7/1856	beach	1		Storer 1867
Provincetown, Mass.	42°04′	70°11′		beach	5		Storer 1867
Provincetown, Mass.	42°04′	70°11′	–/8/1879	beach	1		Bean 1884
Woods Hole, Mass.	41°32′	70°39′	3/1/1884		1		Smith 1898
'Albatross' Sta. 2402	28°36′	85°33′			1		Goode and Bean 1895
'Fish Hawk' Sta. 1044	38°37′	73°12′	10/10/1881		1	39	Goode and Bean 1895
Buzzards Bay	41°35′	73°12′	10/10/1881	beach	21	45–46	Sumner, Osburn and Cole 1913
Grand Manan, N.B.	44°30′	66°45′	1896	beach	1		Cox 1896
Grand Manan, N.B.	44°30′	66°45′			1		Prince 1913
Welchpool, Campobello	44°50′	66°56′	13/7/1914	pollock	1		Huntsman 1922
Wilsons Beach, Campobello	44°55′	66°55′	27/7/1914	beach	1		Huntsman 1922
Platts Bank	43°10′	69°45′	27/7/1924	cod	1	41	Schroeder 1931
Cashes Ledge	42°52′	68°40′	16/8/1928	cod	1	43	Schroeder 1931
7 m. SE Bakers Is. Mt. Desert. Me.	44°15′	68°10′	24/7/1930	pollock	4	32–39	Schroeder 1931

*A number of these records are listed, sometimes with variations, by subsequent authors.

TABLE 2.—Collections of *Maurolicus muelleri* in the northwestern Atlantic

Location	Lat.	Long.	Date	Source	No.	Standard L. mm.
Off Brier Is., N.S.	44°13′	66°37′30″	15/6/60	pollock	2	28.5, 33
Off Campobello, N.S.	44°57′	66°55′	24/7/60	pollock	1	
Off Brier Is., N.S.	44°13′	66°37′30″	7/6/61	pollock	4	23, 26, 27, 28.5
Off Brier Is., N.S.	44°17′30″	67°00′	21/7/61	pollock	2	
Scotian Shelf	43°25′	60°57′	7/7/59		1	26
Scotian Shelf	43°22′	61°14′	6/7/59	pollock	1	27.5
Scotian Shelf	43°33′	60°39′	8/7/59	haddock	1	
Scotian Shelf	44°26′	58°07′	26/7/59	cod	1	31

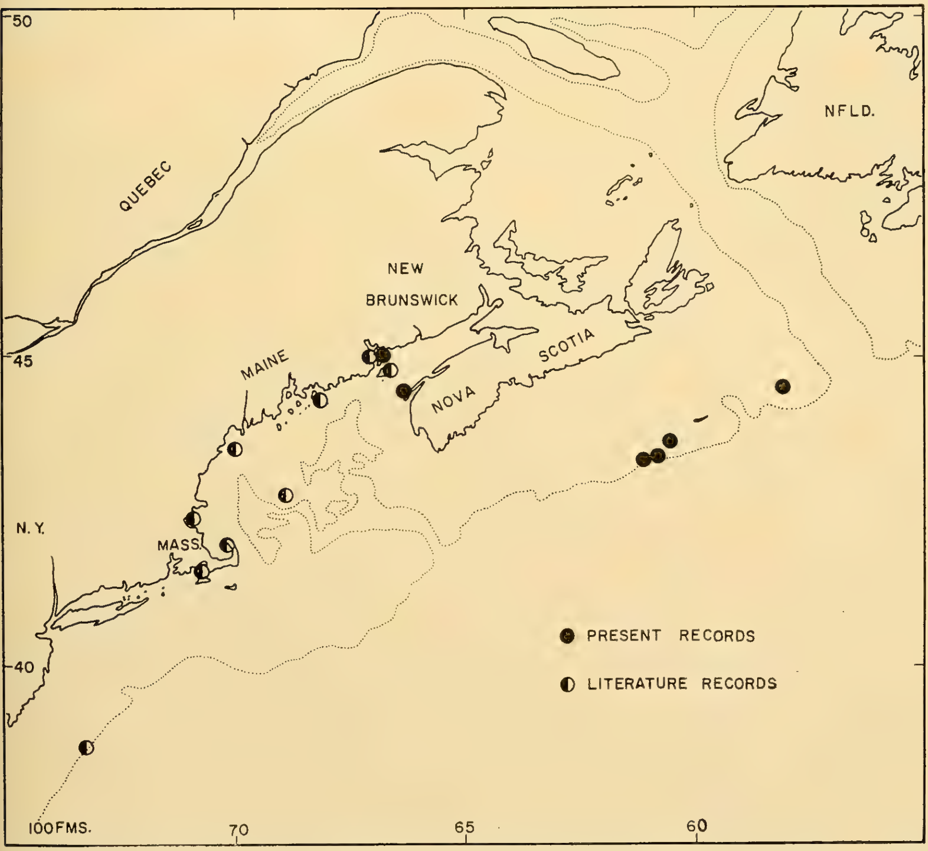

FIGURE 1. The distribution of pearlsides in the northwestern Atlantic.

The following references are given in order to bring together all the original records of collections of this rare fish.

REFERENCES

BEAN, T. H. 1884. List of fishes collected by the U.S., Fish Commission at Woods Hole, Mass., during the summer of 1881. Report of the Commissioner for 1881. U.S. Commission of Fish and Fisheries 9· 339-344.

COX, P. 1896. Report on Zoology. Bulletin of the Natural History Society of New Brunswick. 14, Appendix: 55-57.

GOODE, G. B. and T. H. BEAN. 1896. Oceanic Ichthyology. Smithsonian Contribution to Knowledge 30: 1-553.

GREY, M. 1964. Family Gonostomidae *in* Fishes of the Western North Atlantic. Memoir Sears Foundation for Marine Research No. 1, Pt. 4: 225-237.

HUNTSMAN, A. G. 1922. The Fishes of the Bay of Fundy. Contributions to Canadian Biology being Studies from the Biological Stations of Canada. 1921 (3): 49-72.

PRINCE, E. E. 1913. The Pearlsides. A luminous fish new to Canada. Rod and Gun in Canada 14(11): 1143-45.

SCHROEDER, W. C. 1931. Notes on certain fishes collected off the New England coast from 1924 to 1930. Bulletin of the Boston Society of Natural History 58: 3-7.

SMITH, H. M. 1898. Fishes found in the vicinity of Woods Hole. Bulletin of the United States Fish Commission for 1897, 17: 85-111.

STEELE, D. H. 1963. Pollock (*Pollachius virens* (L.)) in the Bay of Fundy. Journal of the Fisheries Research Board of Canada 20(5): 1267-1314.

STORER, D. H. 1839. Reports on the fishes, reptiles, birds of Massachusetts. Report of the Commissioners on the Zoological and Botanical Survey of the State. Boston (not seen).

———. 1867. A History of the Fishes of Massachusetts. 287 pp. Cambridge and Boston.

SUMNER, F. B., R. C. OSBURN and L. J. COLE. 1913. A Biological Survey of the Waters of Woods Hole and Vicinity. Pt. 2, Section III. A Catalogue of the Marine Fauna. Bulletin of the Bureau of Fisheries 31(2): 549-794.

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MASS OCCURRENCES OF THE FERN, *OPHIOGLOSSUM VULGATUM*, IN THE OTTAWA DISTRICT, ONTARIO

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Ophioglossum vulgatum L. var. *pseudopodum* (Blake) Farwell is an inconspicuous fern noted by Cody (1956) to be extremely rare in the Ottawa District. In August, 1966, I found five new stations for this fern quite close to Ottawa. Two sites contained only a few dozen plants each so are not mentioned further in this report. At the other three sites the plants were numerous enough to justify use of the term "mass occurrences".

SITE 1

Location: Carleton County, 2.3 miles southwest of Ramsayville, Topographic Map Sheet 31G/5 East, Ottawa, 1: 50,000; UTM local grid references 525218 to 536223, Lat. 45° 21′ 10″ N, Long. 75° 36′ 0″ W.

Habitat: The substrate is almost pure coarse-grained sand, underlain at a depth of a few feet by flat-lying, impervious shale. On this late-Pleistocene sediment a thin, very sandy poor soil has developed under mixed moist forest. The whole area was at one time cleared, but most of the attempts at cultivation

were abandoned long ago, and the forest is beginning to regenerate in those areas which are not grazed.

The impervious basement makes drainage poor, and the low forest is damp for much of the year except on some small ridges three or four feet high. The habitat is moist for a considerable period in spring and early summer. In places, the ditch bottoms remain flooded for several months of each year.

The low forest back of the ditch appears to be perhaps twenty years old. It is made up of *Populus tremuloides*, with some *Alnus rugosa*, *Salix* spp. and *Acer rubrum*. The dry ridges are populated by *Pinus strobus*, and some areas have been planted with pine as reforestation plots.

The ditch vegetation is quite varied, including coarse grasses as the common dominant, short mosses, goldenrods, asters, Sensitive Fern (*Onoclea sensibilis*), patches of bulrush, and some uncommon plants such as *Polygala polygama*. The presence of a high calcium content in the soil is indicated by the occurrence of Fen Orchis (*Liparis loeselii*), and Nodding Ladies' Tresses (*Spiranthes cernua*).

Thousands of plants of *O. vulgatum* grow on both sides of the road over a distance of 1000 yards, but only on the slopes between the bottom of the ditch and the woods. The colonies are irregularly scattered and of different sizes, ranging from single plants to groups of many hundreds. The ferns are mainly found in patches of thin coarse grass, so thin that the lower vegetation may be seen on looking down into the grass.

SITE 2

Carleton County, 3.4 miles south southeast of Ramsayville, Topographic Map sheet 31G/5 East, Ottawa, 1:50,000; UTM local grid references 565195 to 571198; Lat. 45° 30′ 31″ N, Long. 75° 20′ 0″ W.

Habitat: As in Site 1. The forest at this location is probably ten years older than at Site 1, but conditions are otherwise similar. The ditch vegetation is denser, with more *Onoclea sensibilis* and larger zones of dense grass. Companion plants include *Liparis loeselii*, Ragged Orchis (*Habenaria lacera*), and *Malaxis unifolia*. In one of the patches of *Ophioglossum* there are a few plants of the Small Grape Fern, *Botrychium simplex* var. *tenebrosum*, and of *Drosera rotundifolia*.

There are many hundreds of plants of *O. vulgatum* distributed over a distance of 700 yards on the south side of the road, once again on the ditch bank next to the forest. The groups are not as large as those at Site 1, and are more openly scattered.

SITE 3

Russell County, 3.3 miles south southwest by west from Rockland, Topographic Map Sheet 31G/11 West THURSO 1:50,000, UTM local grid reference 739392 to 743392.

Habitat: As in Site 1. The location is on the top level of the series of old raised beaches along the top of the escarpment south of the Ottawa river.

The backing forest is much older that at the other two sites, perhaps fifty to sixty years old, but is of similar composition. There is more dense grass,

so that the fern colonies are more widely scattered. Companion plants include asters, *Solidago*, and *Onoclea sensibilis*, and at the end of August *Spiranthes cernua* was most striking in colonies of hundreds of plants.

Many hundreds of plants of *O. vulgatum* are spread over a distance of 400 yards on the north side of the road; one small colony was seen on the south side. As in the other two sites, the ferns grow on the ditch slopes adjacent to the moist forest.

Since "Ferns of the Ottawa District" was published, there have been other findings of *Ophioglossum* sites fairly close to Ottawa, but in largely natural habitats. Comparing the natural sites and the man-created sites, certain points of similarity appear. The most important similarity seems to be poor soil, which reduces the pressure of competition. All the locations which I have examined have shade for part of the day from overhanging trees or at least tall grass, but otherwise vary from dense cedar woods with moist soil to low cover on thin soil on rock or almost pure sand. It seems likely that the ditch slope habitat is nearly ideal for Ophioglossum, if only because the plants at these sites are so very numerous compared with populations in more natural sites. However, it is also probable that the ditch sites are ephemeral, and that populations in them will be much reduced as heavier cover develops. Nonetheless, the lifetime of such habitats will certainly be of the order of from 10 to 15 years, at least.

Hagenah (1966) includes *O. vulgatum* in his survey of distribution of the Ophioglossaceae in Michigan. His observations of abundance and ecology parallel those reported here. In particular, he concludes that the several species have undergone a population explosion since the original forests were lumbered The increase in numbers is undoubtedly due to the creation by man of habitat types which were unusual in the original forest area.

The locations reported here, and two more, were discovered by accident during field trips in search of other plants. This seems to indicate that *Ophioglossum vulgatum*, although no doubt a rare plant, is much less rare than is shown by the sparse record of sightings previously recorded. The plant is small and inconspicuous and is often hidden by other vegetation. Despite this, it is probable that many more locations for this fern would be discovered if a deliberate search was undertaken, especially in suitable disturbed sites.

Specimens from the sites listed have been deposited in the National Herbarium (CAN) and the herbarium of the Department of Agriculture (DAO), Ottawa.

I am grateful to Mr. W. K. W. Baldwin for his comments on the original draft of this paper and to Mr. W. J. Cody, Plant Research Institute, Ottawa, for bringing Hagenah's paper to my attention.

REFERENCES

CODY, W. J. 1956. Ferns of the Ottawa District. Canada Department of Agriculture, Ottawa. Publication 974. 94 pp.

HAGENAH, D. J. 1966. Notes on Michigan Pteridophytes, II. Distribution of the Ophioglossaceae. American Fern Journal 56(4) : 150-163.

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MILLIPEDS (DIPLOPODA) IN THE VICINITY OF LONDON, ONTARIO

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During the summer of 1964 a study of the distribution of terrestrial sowbugs in the vicinity of London, Ontario was made in connection with the programme of studies of non-insect invertebrates sponsored by the National Museum of Canada. A report on this study was presented by Judd (1965b). At the same time that sowbugs were being collected a search was also made for millipeds. Between May 11 and September 1 collections were made in twenty-six localities (lettered from A to Z, Figure 1). Each locality was visited three times during the season. Millipeds were collected by removing the bark from logs and stumps, by turning over logs, boards, stones, piles of trash and other objects on the ground and by examining debris along the edge of bodies of water and damp areas in the various localities. In and around greenhouses a search was made beneath pots, potting benches and seed flats and in piles of manure and discarded plants.

The map (Figure 1) was traced from the Lucan and St. Thomas sheets of the National Topographic series of maps and shows London and adjacent parts of London Township and Westminster Township in which collections were made. The North Branch and the South Branch of the Thames River meet in the centre of London to form one river which flows westward. Concession lines (3rd to 7th.) shown on the map are those in London Township.

Mr. D. L. G. Noakes aided during the summer of 1964 in collecting and sorting the specimens and Dr. Nell B. Causey, Louisiana State University, Baton Rouge, Louisiana, identified them. Representative specimens of the various species collected are deposited in the collections of Dr. Causey, the Entomology Research Institute, Department of Agriculture, Ottawa and the Department of Zoology, University of Western Ontario. The numbers of specimens of each species collected from the twenty-six localities are shown in Table 1.

The localities in which collections were made and the dates of collection are as follows:

A. Grounds of the University of Western Ontario (May 11, June 17, July 27) : pathways, copses, river banks.

B. Winnett Swamp (May 12, June 18, July 28) : damp soil and river banks overgrown with trees and shrubs.

C. The Coves (May 13, June 19, July 29) : a low plain surrounded by a backwater of the Thames River and with scattered trees and shrubs.

D. Springbank Park (May 14, June 22, July 30) : lawns, wooded gullies and river bank.

E. Byron Bog (May 15, June 23, July 31) : a black spruce-sphagnum bog surrounded by wooded slopes (Judd, 1957a).

F. Watson Street Dump (May 19, June 24, August 4) : city dump with mounds of household debris, ashes and soil; river bank nearby.

G. Walker Ponds (May 20, June 25, August 5) : three kettle lakes surrounded by slopes wooded with deciduous trees.

H. Pond Mills (May 21, June 26, August 6) : two ponds surrounded by grassy and wooded slopes.

I. Banks of South Branch east of Meadowlily Road (May 22, June 29, August 7) : open fields and wooded banks along the river. Meadowlily Road runs north and south between I and J.

J. Banks of South Branch west of Meadowlily Road (May 23, June 30, August 10) : open fields and wooded banks along the river.

K. Greenhouses (May 25, July 1, August 11) : Davis', 1185 Riverside Drive; Sanderson's 1265 Riverside Drive.

L. Reservoir Park (May 26, July 3, August 12) : steep slopes wooded with deciduous trees.

M. Goldenwing Woods (May 27, July 6, August 13) : well-drained woodlot of deciduous trees.

N. Banks of Thames River at Beck Memorial Sanatorium (May 28, July 7, August 14) : fields and steep wooded slopes along the river.

O. Stream at west end of 3rd. Concession (May 29, July 9, August 17) : deep gully with wooded slopes along a small stream.

P. Valley of Medway Creek at 4th. Concession (June 1, July 10, August 18) : steep gullies and flood plain with woods on the slopes and rank weeds on the plain.

Q. Valley of Medway Creek at 5th. Concession (June 2, July 13, August 19) : broad, flat, grassy plain along the creek.

R. Greenhouses (June 3, July 14, August 20) : R1 – Sharratt's, 1085 Brydges St.; R2 – University of Western Ontario.

S. Thames Valley Golf Course (June 4, July 5, August 24) : golfing greens bordered by wooded banks of the river.

T. North Branch east of Clarke Road and south of 7th. Concession (June 5, July 16, August 25) : steep wooded banks with marsh and swamp at the lower levels.

U. White Cedar swamp at southeast corner of Highbury Avenue and the 5th Concession (June 8, July17, August 26) : low, damp ground under white cedars.

V. Marsh at southwest corner of Highbury Avenue and 4th. Concession (June 9, July 20, August 27) : several small, open marshes among fields along a tributary of the North Branch.

W. Backyards and alleys in northeast London (June 10, July 21, August 28) : garbage cans, garden litter and piles of boards and stones.

X. Greenhouses (June 11, July 22, August 29) : XI — Taylor's, 125 Barker St.; X2 — Burston's, 251 Epworth Ave.

Y. Marsh on 6th. Concession west of Adelaide St. (June 12, July 22, August 31) : open cat-tail marsh in low ground.

Z. White Cedar swamp south of the 6th. Concession road and east of Highbury Ave. (June 16, July 24, September 1) : low, damp ground beneath white cedars bordering a stream.

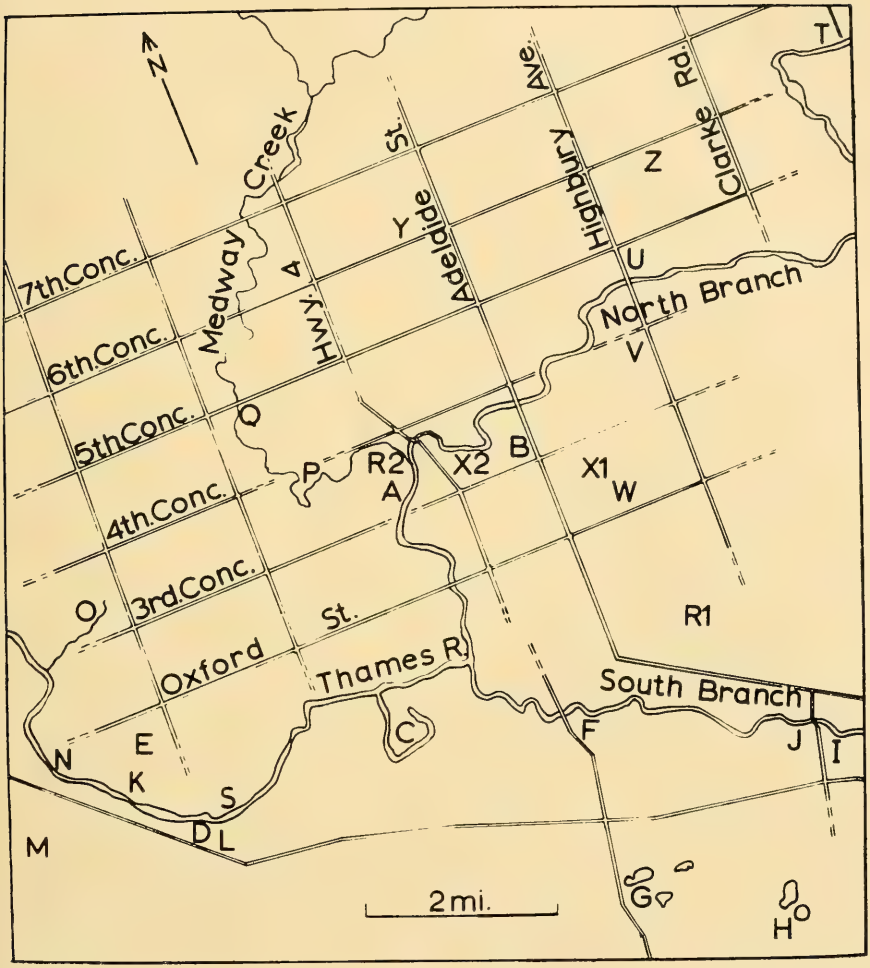

FIGURE 1. Map of London and vicinity showing localities (A-Z) in which millipeds were collected.

ACCOUNT OF SPECIES COLLECTED

Altogether 598 specimens were collected. Twenty-eight immature specimens were identified only to family (Parajulidae). Seventeen identified species were recorded. Nine of these are native to North America and eight introduced from Europe, as will be noted for such species in the following account. The eight introduced species accounted for 505 of the specimens collected, thus indicating that the milliped fauna in the vicinity of London consists largely of introductions. In greenhouses (K,R,X,) only introduced species were found. The most productive localities, yielding from five to eight species, were at sites including woodlots and bodies of water (C,G,O,T,V) where varied assortments of native and introduced species were collected.

POLYZONIIDAE

Polyzonium bivirgatum Wood — Only one was collected, it being found under a stone on damp ground (O) on August 17. This species has been recorded from several places in Ontario (Causey, 1952). Several were found in stripes of fungi in the vicinity of London by Judd (1957b). In the Byron Bog in London several were found in the fungus *Lactarius rufus* (Judd, 1965a). Johnson (1954) records this species from Michigan.

POLYDESMIDAE

Brachydesmus superus Latzel – All specimens collected were in localities (B,C,G,V) adjacent to bodies of water or marshes and most of them were found under wet leaves, though some were beneath logs. Johnson (1954) records this species from Michigan. Chamberlin and Hoffman (1958) record it as a native of Europe, widely distributed elsewhere by commerce and state that it is abundant in gardens and cultivated areas. Its occurrence in the various localities around London is in accord with Chamberlin and Hoffman's report, for all such localities are within the city limits and not far from houses.

Polydesmus inconstans Latzel – This species was found in various situations, as under rubbish and boards (A,C,), under sticks, leaves and logs (E,F,G,J,O,T,V,Z), under a board by a greenhouse (K), under a basket in a greenhouse (X), and on August 7 one was found coiled beneath a puffball on the ground (I). Chamberlin and Hoffman (1958) record that it is widespread in Europe and has been introduced into cultivated areas in North America.

Pseudopolydesmus serratus (Say) – Only two were found, one on May 27 in wet leaves under a log (M) and the other on July 24 in very wet mud under a log (Z). Causey (1955) records this species from eastern North America and Johnson (1954) records it from Michigan. Chamberlin and Hoffman (1958) record it as native to northeastern North America.

Scytonotus sp. – Two immatures were collected, one on May 20 from under sticks at the edge of a pond (G) and the other on August 13 from under wet leaves in a shaded hollow (M). Being immature they were not identifiable to species. *Scytonotus granulatus* (Say) has been collected in Ontario (Causey, 1952), Michigan (Johnson, 1954) and other localities in the eastern United States (Causey, 1955; Chamberlin and Hoffman, 1958). This genus is native to North America (Chamberlin and Hoffman, 1958).

PARADOXOSOMATIDAE

Oxidus gracilis (Koch) – One was found on June 25 under a rotten stump (G). The other 40 specimens were all collected in greenhouses (R,X) from under flats, flower pots, boards, baskets and on cement walls behind objects against the walls. The presence of this species in greenhouses is in accord with the report of Chamberlin and Hoffman (1958) that it is an introduced species well established in southern and western United States and found throughout the country in greenhouses.

CLEIDOGONIDAE

Cleidogona sp. – These were collected in damp or wet situations as under damp leaves in a woodlot (M) or under sticks, leaves and bark lying on the

TABLE 1.—Numbers of millipeds collected in the twenty-six localities

Species	Localities																										Totals
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Polyzonium bivirgatum															1												1
Brachydesmus superus		3	3			1	1															1					9
Polydesmus inconstans	3		3		1	12	6		1	3	1				1					3		2		2		3	41
Pseudopolydesmus serratus													1													1	2
Scytonotus sp.							1						1														2
Oxidus gracilis							1											12						28			41
Cleidogona sp.									2				4							2		1					9
Underwoodia iuloides															1												1
Brachyiulus pusillus						3				2							2		1			3	2	1	1		15
Diploiulus caeruleocinctus	15	14	5	9	11	6		2		4	46	3	1	3	4	3	5	16	22	6	2	5	1	12	18	2	215
Ophyiulus pilosus	16	19	2		5		14	7	14	6		30	6		5	3	3	4	2	6	6	21	3	1	1	5	179
Balaniulus guttulatus							1												1								2
Choneiulus palmatus														1	1					1							3
Aniulus bollmani	2	3	4		2									1						5							17
Aniulus paludicolus																									1	2	3
Oriulus venustus							1														1						2
Ptyoiulus impressus					1							7			3												11
Uroblaniulus ellipticus										3																	3
Uroblaniulus jerseyi												5				1											6
Uroblaniulus sp.			1									2			2				2	1							8
Paraiulidae (immature)	3	3		1	1				3			2	1		1	2		6		2		2				1	28
	39	42	18	10	21	22	25	9	20	18	47	49	14	5	19	9	10	38	28	26	9	35	6	44	21	14	598

ground in the vicinity of bodies of water and marshes (I,T,V), Causey (1952) collected *Cleidogona* in a willow swale in Ontario. Johnston (1954) records one species from Michigan and Causey (1957) and Chamberlin and Hoffman (1958) record it as a genus native to North America with several species in the eastern United States.

UNDERWOODIIDAE

Underwoodia iuloides (Harger) – One was collected on May 29 from under a stick among damp leaves in a gully (O). Chamberlin and Hoffman (1958) record this as a species native to North America, its type locality being in Ontario and other collection localities being in Michigan and New York.

JULIDAE

Brachyiulus pusillus (Leach) – Most specimens were collected from damp spots under boards, rocks, wet leaves and fallen trees adjacent to bodies of water (J,Q,S,V) and under cat-tails in a marsh (Y). Others were found near human surroundings such as on a city dump (F), under garbage cans (W) and under a board in a greenhouse (X). Chamberlin and Hoffman (1958) record this species as native to Europe and occurring in the northern part of North America in developed areas, thus being doubtless an introduced species.

Diploiulus caeruleocinctus (Ward) – This was the commonest species found, accounting for more than one-third of the specimens collected. It was found in all but two localities (G,I). About half the total number were found in five situations close to human habitations such as the grounds of the university (A), greenhouses (K,R,X) and a golf course (S). It also occurred in lesser numbers in other places such as river banks, wooded gullies, slopes of the Byron Bog (E), woodlots and marshes. It has previously been reported from the Byron Bog by Judd (1964) and from Michigan by Johnson (1954). Chamberlin and Hoffman (1958) record that it has been introduced from Europe and now occurs abundantly throughout the New England States and adjoining parts of Canada. Its distribution around London indicates that while it is abundant around human habitations it is also adapted to living in a variety of habitats under more natural conditions.

Ophyiulus pilosus (Newport) – This was one of the commonest species collected, occurring in all but four of the localities (D,F,K,N). The greatest number from one locality was found in Reservoir Park (L) under leaves on the wooded slopes. It was also found in a variety of other situations such as greenhouses (R,X), backyards (W), ravines and about marshes. It was collected previously from the Byron Bog (Judd, 1964) and has been recorded from Michigan by Johnson (1954). Chamberlin and Hoffman (1958) record it as a native of Europe from where it has been introduced into cultivated areas of North America.

NEMATOSOMATIDAE

Blaniulus guttulatus (Bosc) – Two were collected, one on August 5 from under a log on a hillside (G) and one on August 24 from beneath wet leaves on a river bank (S). Chamberlin and Hoffman (1958) record this species as

widespread in Europe and now established generally in cultivated areas of the United States and Canada.

Choneiulus palmatus (Nemec) — Three were collected, one on May 28 from under a log on a river bank (N), one on May 29 from under a stick among damp leaves in a gully (O) and one on July 16 from under leaves on a hillside (T). Chamberlin and Hoffman (1958) record this species as native to Europe and known definitely from Nova Scotia and likely to be found elsewhere in North America as a synanthropic species. The record from London thus establishes that this species is more widely spread in North America than heretofore known.

PARAJULIDAE

Aniulus bollmani Causey — Several were found under logs, leaves and bark on the ground (A,B,C), under rubbish (N) and under boards and logs near the river (T). Two were also found under bark on the ground on the wooded slopes of the Byron Bog (E) where this species was found previously by Judd (1964). Causey (1952) records this species from elsewhere in Ontario, Judd (1957b) found some coiled in the stipes of fungi near London and Johnson (1954) records it from Michigan. Chamberlin and Hoffman (1958) record it as a species native to North America.

Aniulus paludicolus Causey — Three were collected, one on August 31 from under a log on wet ground in a cat-tail marsh (Y) and two on September 1 from under a rotten log in a white cedar swamp (Z). This species was collected under similarly wet conditions in the Byron Bog (E) by Judd (1964).

Oriulus venustus (Wood) – Two were collected, one on May 20 from a fallen tree in an open field (G) and another on July 17 from under leaves on damp ground (U). Causey (1952) has collected this species in Ontario and Johnson (1954) records it from Michigan. Chamberlin and Hoffman (1958) record it as native to North America.

Ptyoiulus impressus (Say) – One was collected on June 23 from under wet leaves (E), seven on July 3 from under wet leaves (L) and three from beneath rubbish on July 9 (O). This species has been recorded from Michigan by Johnson (1954) under the name *pennsylvanicus*. Chamberlin and Hoffman (1958) record it as native to eastern North America.

Uroblaniulus ellipticus (Bollman) New Combination – Three were found on August 10 under a fallen tree in a wood (J). Johnson (1954) records this species under the name *Hakiulus diversifrons* (Wood) from Michigan and Chamberlin and Hoffman (1958) report it as native to North America.

Uroblaniulus jerseyi (Causey) – Six were collected, five of them on August 12 from beneath sticks and damp leaves on a hillside (L) and one on August 18 from under a pile of sticks on a river bank (P). Causey (1952) records this species from Ontario under the name *canadensis* (Newport) and Johnson (1954) records it under the same name from Michigan. Chamberlin and Hoffman (1958) report that it is native to northeastern United States and Canada.

Uroblaniulus sp. – Eight were collected from five localities (C,L,O,S,T) which were predominantly wooded areas. Chamberlin and Hoffman (1958) record several species of *Uroblaniulus*, all native to eastern North America.

REFERENCES

CAUSEY, N. B. 1952. New records of millipeds from southern Ontario. Canadian Field-Naturalist 66: 145.

————. 1955. New records and descriptions of polydesmoid millipeds (Order Polydesmida) from the eastern United States. Proceedings of The Biological Society of Washington 68: 21-30.

————. 1957. New records and descriptions of millipeds of the family Cleidogonidae (Order Chordeumida). Journal of The Kansas Entomological Society 30: 114-120.

CHAMBERLIN, R. V., and R. L. HOFFMAN. 1958. Checklist of the millipeds of North America. United States National Museum Bulletin No. 212.

JOHNSON, B. M. 1954. The millipeds of Michigan. Paper of The Michigan Academy of Science, Arts and Letters 39: 241-252.

JUDD, W. W. 1957a. Studies of the Byron Bog in southwestern Ontario. I. Description of the bog. Canadian Entomologist 89: 235-238.

————. 1957b. A collection of insects and millipeds from fungi in Ontario.. Transactions of The American Microscopical Society 76: 311-316.

————. 1959. Studies of the Byron Bog in southwestern Ontario. X. Inquilines and victims of the pitcher-plant, *Sarracenia purpurea* L. Canadian Entomologist 91: 171-180.

————. 1964. Studies of the Byron Bog in southwestern Ontario. XXI. Distribution of centipedes (Chilopoda) and millipedes (Diplopoda). Natural History Pappers, National Museum of Canada No. 26.

————. 1965a. Studies of the Byron Bog in southwestern Ontario. XX. Insects and millipeds associated with fungi. Canadian Field-Naturalist 79: 25-28.

————. 1965b. Terrestrial sowbugs (Crustacea: Isopoda) in the vicinity of London, Ontario. Canadian Field-Naturalist 79: 197-202.

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NEW BIRD RECORDS FROM ALASKA AND THE ALASKA HIGHWAY

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THIS PAPER PRESENTS RECORDS of unusual interest obtained on two trips to Alaska. On the first of these, in August-September, 1956, I was accompanied by my brother Anthony, and visited Hooper Bay, the Pribilofs, and Mount McKinley Park. On the second, in July-August 1965, I was accompanied by my wife, and visited Nome, Wales, and Mount McKinley Park. On this latter trip we drove up the Alaska Highway. Detailed notes were taken, but only the most significant are here presented for publication. Further notes of lesser interest have been deposited with Dr. Brina Kessel, of the University of Alaska.

I am indebted to many people in connection with this paper. I am doubly indebted to Dr. Brina Kessel of the University of Alaska, both for help while in Alaska and for critical reading of the manuscript. Dr. Dean Amadon also read the manuscript and made suggestions. Dr. Walter J. Breckenridge kindly allowed me to incorporate his notes on the White Wagtail and Red-throated Pipit. For help in the field in Alaska I am grateful to many people, and in

particular I should like to thank Dr. Adolph Murie (McKinley Park); John J. Burns, U.S. Fish and Wildlife Service, (Nome); and the Rev. Henry Hargreaves, S. J. (Hooper Bay).

List of Species

Erolia acuminata Sharp-tailed Sandpiper

A brief and inaccurate note in Gabrielson and Lincoln (1959, p. 372) records that "A. Stuart Keith (ms) reported it to be common at Hooper Bay September 5-14, 1957". The dates are right, but the year was 1956.

The Sharp-tailed Sandpiper is a little-known bird with a curious migration route. It breeds in eastern Siberia east to the delta of the Kolyma River, and according to Vaurie (1965) it has been taken in summer, but breeding not proven, on the Chukotski Peninsula (the peninsula opposite Alaska on the west side of Bering Strait). There is no breeding record for North America. It migrates down the coast of eastern Asia to winter in the Southwest Pacific from New Guinea and the Tongas to Australia and New Zealand.

The curious fact is, however, that quite large numbers of Sharp-tailed Sandpipers turn up in North America during fall migration. Extreme dates given by Gabrielson and Lincoln (1959) for Alaska are August 19 and October 26, with most records being for September. A wide variety of localities is listed, and in some places the bird was evidently common. E. W. Nelson (*in* Gabrielson and Lincoln, 1959) found it common in the fall at St. Michael, 1877-1880. St. Michael is on the Bering Sea coast of Alaska about 200 miles north of Hooper Bay. Fair numbers have been taken on St. Lawrence Island, Nunivak Island, and on the Pribilofs. There are also records for southeast Alaska and Munro and Cowan (1947) record it as a fall transient on the coast of British Columbia, occasionally plentiful. South of the United States-Canadian border, however, it becomes rare, and the birds evidently do not winter in North America, nor anywhere in the eastern Pacific. In Hawaii it is listed as casual by the A.O.U. Checklist (1957), but judging from repeated occurrences reported in *The Elepaio* recently, it may be regular there.

My own experience at Hooper Bay in September 1956 gives further evidence that the Sharp-tailed Sandpiper is a regular, not an accidental, fall visitor to Alaska. I noted in my diary that, "Three out of every four shorebirds is a sharp-tail". On a walk between the village and the sea, a distance of about a mile, one might easily encounter about two dozen of these birds. They were found with other shorebirds around the small pools on the tundra.

The intriguing question arises, why should some Sharp-tailed Sandpipers cross over to North America during their fall migration, instead of following the others down the coast of Asia? A regular eastward drift during fall migration is a phenomenon well known for certain North American land birds, but I can find no parallel for an Asian bird regularly drifting east to North America during fall migration. The large numbers seen by me and others rule out the possibility that these are casual, storm-drifted birds.

In view of Gabrielson and Lincoln's remark (*loc. cit.* p. 372) that the Sharp-tailed Sandpiper looks so much like the Pectoral Sandpiper that it can be easily overlooked, and that about the only recognisable field character is

the more ruddy general color of the upper parts (statements with which I do not agree), I include some remarks on field identification.

I have never seen a Sharp-tailed Sandpiper in breeding plumage in the field, but judging from museum specimens it should not be hard to tell from the Pectoral. The breast is spotted, not streaked, and is washed with rufous buff. The spots taper off into V-shaped markings which cover the flanks and part of the belly (flanks and belly plain white in Pectoral). The belly is buff, not white, and there is no sharp demarcation between the spotted and the unspotted parts, as there is in the Pectoral. The upper parts are much ruddier, and in particular the cap is rich rufous. In fall and winter the situation is much easier, because whereas the Pectoral retains its heavily streaked throat and breast, the Sharp-tailed loses all marks on the underparts except for a few streaks on the lower throat and the sides of the breast. In addition, young birds have the breast rufous and a very noticeable white superciliary stripe, contrasting with the rusty cap.

Apart from plumage characters, there is a very distinct difference between the calls of the two species. The Sharp-tail has a plaintive "chew" or "wheep", quite different from the dry "prrrt" of the Pectoral. The rendering in Peterson (1961) of the call of the Sharp-tail as "trrit-trrit", *fide* B. W. Tucker, is misleading, as this suggests a Pectoral, and I never heard any such note from a Sharp-tail. The only Pectoral we saw at Hooper Bay was immediately picked out from the Sharp-tails by its call. Pough (1957) does better in giving the Sharp-tail's call as "A soft, metallic pleep, pleep".

All my birds from Hooper Bay were in the rufous immature plumage. Ridgway (1919) states that all Alaskan specimens examined by him were also in immature plumage.

Motacilla alba White Wagtail

Occurrences of the White Wagtail in Alaska through 1961 have been summarised by Peyton (1963).

Dr. Walter J. Breckenridge saw a White Wagtail on Little Diomede Island in Bering Strait on June 14 and 15, 1965.

The village of Wales has perhaps more records of White Wagtails than anywhere else in Alaska, and it is quite probable that the bird nests there every year. Bailey (1948) saw one near the school in June, 1922, and Dwight Tevuk, a former collector for Bailey and now Postmaster of Wales, tells me he sees White Wagtails around the village nearly every year. Peyton (*loc. cit.*) found a nest with eggs in an abandoned house in the village in June, 1961. Breckenridge saw a pair carrying nest material into a house near the school on June 19, 1965, and Mr. Coy Horton, of the U.S. Navy Station, Wales, confirms that a pair nested near the school that year. Breckenridge also reports that he saw a pair repeatedly near Horton's house at the opposite end of the village from the school, and says (pers. comm.) "I assumed they had pretty well established a nesting territory." Horton tells me the birds were seen frequently near his house all summer.

My own observations of the White Wagtail at Wales cover the period July 28-August 10, 1965. On July 28, a juvenile was seen near the school-

house, and six adults were seen together at the deserted military encampment at Belmezok, about a mile north of the village. Two adults were also seen at Horton's house on my way up to Belmezok, but these could possibly have been among the six at Belmezok, having passed me on the way.

On July 31 two juveniles were seen near Horton's house. They were in slightly different plumage to the one seen earlier near the schoolhouse, so this gives a total of seven birds for Wales village, four adults and three juveniles. On later visits to Belmezok only one pair of adults was seen, so I think it safer to assume that the four extra adults there on July 28 were the two pairs that nested at Wales, even though they were a mile from the village, rather than that they were two additional pairs.

On July 31 I discovered the nest of the pair at Belmezok. It was placed above the door of one of the deserted Quonset huts, resting on a 2 x 4, sandwiched in between the outer wall and the inner paperboard insulating layer. The nest was of grass, and lined with insulating wool, of which there was an abundant supply in the wall near the nest. Three large juveniles were in the nest, and a fourth was hopping around on the ground on the floor of the hut, being fed by an adult as I approached.

On August 9 the nest was deserted, and there were no White Wagtails in the Belmezok area.

To sum up, three pairs of White Wagtails nested in the Wales area in the summer of 1965, and at the time of my visit seven juveniles could be seen, for a total of 13 birds.

Anthus cervinus Red-throated Pipit

Gabrielson and Lincoln (1959) say that "This Siberian species has appeared in Alaska three and possibly four times," and as the most important record for it they cite the nest found at Wales by Dwight Tevuk in 1931.

Dr. Breckenridge states (pers. comm.) that he saw "at least half a dozen" Red-throated Pipits at Wales in 1964, and collected a male in breeding condition (testes 9 mm.) on June 1. In 1965 he saw even more Pipits, and collected a female on June 11, with slightly enlarged ova. (largest 2 mm).

On July 29, 1965, I saw three Red-throated Pipits in three quite separate areas on Wales Mountain. On August 2, I collected a pair and a juvenile which was full grown except for a very short tail, and well able to fly. The location was on Wales Mountain about half a mile above the village, at a point where the high tundra ends and the rocks begin.

This is the first juvenile Red-throated Pipit collected in North America, and the second proven breeding record for the continent. I suspect, though, in view of the numbers of birds seen by Breckenridge and myself, that the Red-throated Pipit may be a regular nester at Wales.

Recent literature has provided further evidence of the occurrence of the Red-throated Pipit in North America. Watson (1963) records a bird collected on St. Lawrence Island in 1938 but not previously published on. McCaskie (1966) describes a flock of at least 17 birds at Imperial Beach, California, in October, 1964.

Piranga ludoviciana Western Tanager

On July 11, 1965, I saw a male in full breeding plumage at Wonder Lake Campground, Mt. McKinley National Park. It was observed at a distance of 15 feet in good light, and is in any case unmistakable in this plumage.

This is the fourth record of the Western Tanager for Alaska. Gabrielson and Lincoln (1959) mention two records only of its occurrence. One of these is quite predictable, being from the Stikine River in southern Alaska, just over the border from British Columbia, where the bird is known to occur. The other record is far more surprising, being from Barrow in far northern Alaska. A third bird was recently seen by Stewart (1964) at Petersburg in southern Alaska. This, again, is a locality where the bird might be expected. My bird from McKinley Park is so far from its known breeding area in British Columbia that it should be classed with the Barrow bird as purely a straggler.

Chondestes grammacus Lark Sparrow

A single bird was flushed from the roadside of the Alaska Highway at mile 190 on Trutch Mountain on July 2, 1965. This is in northeastern British Columbia about 100 miles south of Fort Nelson. I recognized the bird immediately from the distinctive tail pattern in flight. It landed in the road enabling me to see the chestnut face patch and other distinguishing marks at close range for several minutes.

This locality is far north of the bird's known range. It nests in extreme southern British Columbia and southern Alberta, and according to Munro and Cowan (1947) wanders casually north to the Cariboo Parklands Biotic Area, roughly 400 miles south of Trutch Mountain in British Columbia. Salt and Wilk (1958) state that the Lark Sparrow has been recorded in Alberta as far north as Botha, which is still 600 miles southeast of Trutch Mountain.

REFERENCES

AMERICAN ORNITHOLOGISTS' UNION, 1957. Checklist of North American birds.

BAILEY, A. M. 1948. Birds of Arctic Alaska. Colorado Museum of Natural History, Popular Series No. 8.

GABRIELSON, I. N. and LINCOLN, F. C. 1959. The Birds of Alaska. Wildlife Management Institute, Washington, D.C.

MCCASKIE, R. G. 1966. The Occurrence of Red-throated Pipits in California. Auk 83: 135-6.

MUNRO, J. A. and COWAN, I. MCT. 1947. A review of the Bird Fauna of British Columbia. Special Publication No. 2, British Columbia Provincial Museum, Victoria, B.C.

PETERSON, R. T. 1961. A Field Guide to Western Birds. Houghton Mifflin Co.

PEYTON, L. J. 1963. Nesting and Occurrence of White Wagtails in Alaska. Condor 65: 232-235.

POUGH, R. H. 1957. Audubon Western Bird Guide. Doubleday & Co.

RIDGWAY, R. 1919. The Birds of North and Middle America. Bulletin of the U.S. National Museum No. 50, Part 8.

SALT, W. R. and WILK, A. L. 1958. The Birds of Alberta. Hamly Press, Edmonton.

STEWART, P. A. 1964. Bird Notes from Southeastern Alaska. Condor 66: 78-79.

VAURIE, C. 1965. The Birds of the Palaearctic Fauna, Non-Passeriformes. Witherby, London.

WATSON, G. E. 1963. A second Record of the Red-throated Pipit from St. Lawrence Island, Bering Sea. Condor 65: 447.

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OBSERVATIONS ON THE POLLINATION BIOLOGY OF PLANTS ON MELVILLE ISLAND, N.W.T., CANADA

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WHILE COLLECTING PLANTS and insects on Melville Island, N.W.T., Canada from July 19 to July 31, 1965, we made some observations on the occurrence and behavior of flower-visiting insects as well as on the scent and other target characteristics of flowers. These observations were made about two miles north of Bailey Point in an area where a deep river valley bisects an otherwise rolling topography (75°N 114°58′W). A paper dealing with chromosomal and taxonomic characteristics of the flora at this locality has already been published (Mosquin and Hayley, 1966). The present account includes only those species of plants which had well-developed open flowers at the time of our visit to the site.

All Diptera listed in Table 1 were collected individually with an aspirator and placed in separate vials together with a note identifying the plant on which the collection was made. Only those Diptera which were actually probing into the flower are listed in the table. The Lepidoptera and the bumblebees were collected using a conventional butterfly net.

Most of the insect collections listed in the Table were made during the three days, July 22, 23 and 24 when the sky was clear, the winds relatively calm and the temperature in the warm fifties. Several of the Diptera visitors are shown in Figure 1.

SPECIES WITH SCENTED FLOWERS

Astragalus alpinus L. This species occurred in colonies up to many meters in diameter. The sweet, honey-like scent from such colonies was often detected from a distance of several yards or more.

Parrya arctica R. Br. This species occurred usually as scattered individuals although the species is often locally abundant. In seemingly sterile environments the plants had small inflorescences and these were scentless. However, plants growing in more favorable sites had well-developed and lush inflorescences. Such inflorescences, if bunched together, had a distinctive pungent sweet-mustard aroma.

Petasites frigidus (L.) Fries. This species, although very abundant in the area was just beginning to flower during the last few days of our visit. The flowers had a very sweet and pungent fragrance. The flowers of this species are apparently fragrant throughout its arctic range (see Porsild, 1957, p. 150).

In addition to these three species, two others, *Epilobium latifolium* L. and *Senecio congestus* (R. Br.) DC., since they have showy flowers, may well have been scented but they had not yet started flowering by the end of our visit.

SPECIES WITH APPARENTLY SCENTLESS FLOWERS

Salix arctica Pall.
Oxyria digyna (L.) Hill
Polygonum viviparum L.
Stellaria longipes Goldie
Stellaria humifusa Rottb.
Cerastium alpinum L.
Melandrium apetalum (L.) Fenzl.
Caltha palustris L. var. *arctica* (R. Br.) Huth. This species may have had a very slight aroma at this locality.
Ranunculus hyperboreus Rottb.
Ranunculus sabinei R. Br.
Ranunculus sulphureus Sol.
Papaver radicatum Rottb.
Cochlearia officinalis L.
Draba spp.
Erysimum pallasii (Pursh) Fern.
Saxifraga caespitosa L.
S. cernua L.
S. flagellaris Willd.
S. foliolosa R. Br.
S. hirculus L.
S. nivalis L.
S. oppositifolia L.
S. tricuspidata Rottb.
Dryas integrifolia M. Vahl
Geum rossii (R. Br.) Ser.
Potentilla hyparctica Malte
P. pulchella Pursh
Oxytropis arctica R. Br.
Cassiope tetragona (L.) D. Don
Pedicularis arctica R. Br.
P. sudetica Willd.
Antennaria angustata Greene
Arnica alpina (L.) Olin
Erigeron compositus Pursh
E. eriocephalus J. Vahl
Taraxacum arctogenum Dahlst.
T. phymatocarpum J. Vahl
T. pumilum Dahlst.

DISCUSSION

Our observations support the general hypothesis dealing with evolutionary patterns of the arctic flora proposed in detail in an earlier paper (Mosquin, 1966). This hypothesis is that in the arctic, genetic uniformity is at a selective advantage. Therefore nearly every species has one or more reproductive devices for promoting population uniformity. Further, features of arctic plants which appear to promote variability, are, in fact, vestigial. For example, features such as showy flowers, nectar production, zygomorphic corollas, and perhaps genetic variability itself are not to be interpreted as evidence that outcrossing has adaptive function to-day but rather these features are evidence of outcrossing in the ancestry. Their presence in the arctic flora is due mainly to the fact that adaptation in the arctic flora is mainly physiological rather than morphological. The evidence is strong to indicate that nearly all arctic species are derived from temperate-zone ancestors (Mosquin, 1966) and that these ancestors are ones that have a preponderance of features which promote variability. The arctic flora of today therefore contains numerous species which carry the morphological vestiges of their outcrossing ancestry. Following are some interpretative comments on our observations.

The absence of pollinators on the two species of *Pedicularis* will be considered first. Both species were very common in the area and are showy-flowered. The flowers are, however, scentless and as far as we could determine, are not visited by the bumblebees which were very common in the area. Pre-

FIGURE 1. Left, an anthomyiid fly, *Pogonomyiodes segnis* Holmgren, feeding on pollen grains of *Dryas integrifolia* M. Vahl. Right, a blow fly, *Boreelus artriceps* (Zetterstedt), presumably taking nectar from flower of *Potentilla vahliana* Lehm. Photographs adapted from kodachrome slides.

sumably, both species have lost their capacity to produce scent such as occurs in many of their temperate-zone ancestors (Sprague, 1962). It is of interest, however, to note that on Somerset Island, where leguminous plants are absent, the bumblebees occasionally did visit *Pedicularis arctica* (Savile, 1959). It seems clear that the remarkable success of the two species of *Pedicularis* at Melville Island does not depend on visits from the bumblebees. Presumably the plants are strongly self-pollinated, since seed-set is high (Savile, personal communication). Self-pollination would ensure a relatively high degree of genetic uniformity through homozygosity.

The two species of Leguminosae provide another interesting example in support of the above hypothesis. Thus *Astragalus alpinus* was, by far, the most bumblebee-visited plant species in the area. Obviously nectar was being produced abundantly. However, whether the presence of the bees is of any value to the plants is questionable. This statement seems justified because another legume species, *Oxytropis arctica*, which occurs in the same general area, and has much larger and more showy flowers, is apparently completely scentless and is not visited by bees as far as we could determine. It is clear that bumblebees are not required in the arctic for the success of *Oxytropis arctica*. Perennial legumes of more southern latitudes are normally self-incompatible and strongly insect pollinated (Fryxell, 1957). A scented legume like *Astragalus alpinus* may not yet have lost its capacity to produce nectar. The visiting insects are presumably only utilizing an available food supply. It is important to determine whether *A. alpinus* is self-incompatible because if it is, it would be an exception to the above hypothesis.

Salix arctica can be considered as another example of an arctic species that has lost its capacity to produce scent. It would be worthwhile to determine whether more southern populations of this species are scented. Certainly nearly

TABLE 1.—Flowering plant species and their insect visitors

	Boloria improba (Nymphalidae)	Colias hecla (Pieridae)	Colias nastes (Pieridae)	Anarta richardsoni (Noctuidae)	Rhamphomyia sp. (Empididae)	Boreellus atriceps (Calliphoridae)	Protocalliphora sp. (Calliphoridae)	Spilogona aesturium (Muscidae)	Spilogona almquistii (Muscidae)	Spilogona dorsata (Muscidae)	Spilogona hurdiana (Muscidae)	Spilogona latilamina (Muscidae)	Spilogona melanosoma (Muscidae)	Spilogona projecta (Muscidae)	Spilogona sanctipauli (Muscidae)	Eupogonomyia probilofensis (Muscidae)	Pogonomyiodes segnis (Muscidae)	Bombus polaris (Bombidae)
Cerastium alpinum (Caryophyllacae)														1 ♂ 1 ♀	2 ♂ 1 ♀			
Caltha palustris (Ranunculaceae)									1 ♀	1 ♂	1 ♀		1 ♀		1 ♂ 2 ♀			
Papaver radicatum (Papaveraceae)									1 ♂								1 ♀	
Potentilla vahliana (Rosaceae)						1 ♂ 2 ♀	1 ♂		2 ♂ 3 ♀	2 ♀		5 ♀	1 ♀		6 ♂ 13 ♀	3 ♂ 4 ♀	1 ♂	
Dryas integrifolia (Rosaceae)	8								3 ♀					1 ♀	11 ♂ 4 ♀	2 ♀	2 ♂ 3 ♀	
Geum rossii (Rosaceae)									1 ♀									
Astragalus alpinus (Leguminosae)		11	1															15
Oxytropis arctica (Leguminosae)				1														
Petasites frigidus (Compositae)																		1
Arnica alpina (Compositae)									1 ♀						2 ♀	1 ♂		
Taraxacum spp. (Compositae)					1 ♀	1 ♂		2 ♀	1 ♂ 2 ♀						1 ♀			

all willows of the temperate areas are strongly insect-pollinated. Arctic willows may well be losing a dependence on insect pollination and evolving toward wind-pollination. A loss of scent might be expected to be associated with such a trend. Evolution in *Salix* from entomophily toward anemophily is suggested by Wodehouse (1935, p. 348) on the basis of various kinds of evidence. The distribution and occurrence of scent in northern willows would be worthy of detailed study.

It is clear from Table 1 and from the papers by McAlpine (1965a, 1965b) that the Diptera are very important flower visitors in the arctic. Many species have strong preferences for the flowers of certain plants. These preferences seem to be closely related to the size of the visual target. Thus plant species like *Dryas integrifolia* and *Potentilla vahliana*, which have very showy flowers were much-visited by the flies. In contrast, we failed to capture any flies on the sweet-scented *Astragalus alpinus*, probably because its purple flowers have about the same reflectivity as adjacent greenery. Likewise the Cruciferae, the various Saxifragaceae, and Caryophyllaceae, since they provide relatively non-conspicuous visual targets are apparently rarely visted by flies.

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The Diptera were identified by the late Dr. J. G. Chillcott and Mr. G. E. Shewell, the Lepidoptera by Drs. T. N. Freeman and D. F. Hardwick and the *Bombus* by Dr. E. Milliron, of the Entomology Research Institute.

REFERENCES

McALPINE, J. F. 1965a. Insects and related terrestrial invertebrates of Ellef Ringnes Island. Arctic 18: 73-103.

————, 1965b. Observations on anthophilous dipetra at Lake Hazen, Ellesmere Island, The Canadian Field-Naturalist 79: 247-252.

FRYXELL, P. A. 1957. Mode of reproduction in higher plants. Botanical Review 23: 135-233.

MOSQUIN, T. 1966. Reproductive specialization as a factor in the evolution of the Canadian flora. *In* The Evolution of Canada's Flora, edited by R. L. Taylor and R. A. Ludwig, University of Toronto Press, 137 pp.

MOSQUIN, T. and D. E. HAYLEY. 1966. Chromosome numbers and taxonomy of some Canadian Arctic Plants. Canadian Journal Botany 44: 1209-1208.

PORSILD, A. E. 1957. Illustrated flora of the Canadian Arctic Archipelago. National Museum of Canada, Bulletin 146.

SAVILE, D. B. O. 1959. The botany of Somerset Island, District of Franklin. Canadian Journal Botany 37: 959-1002.

SPRAGUE, E. F. 1962. Pollination and evolution in *Pedicularis* (Scrophulariaceae). Aliso 5: 181-209.

Wodehouse, R. P. 1935. Pollen Grains. McGraw-Hill Book Co., New York. 574 pp.

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REVIEWS

The Evolution of Canada's Flora

TAYLOR, ROY L. and R. A. LUDWIG (eds.) 1966. University of Toronto Press. pp. i-viii, 1-137. $5.50.

A book of only 137 pages treating the evolution of Canada's flora must of necessity be somewhat spotty in its coverage. What we have here is a volume of eight essays commemorating the Founding Meeting of L'Association Botanique du Canada held at Carleton University, Ottawa, in May 1965. The chapters are based upon a colloquium of papers on Canadian botany. The topics are diverse, ranging from algal communities and moss evolution to the role of man in plant migrations and the ecology of phytogeographic zonation One gains the impression that Canada's flora is not an especially exciting one, being largely attenuated and derivative. But at the same time, detailed investigations on special problems now being carried out in Canada demonstrate a vigor and enthusiasm that promise a fruitful future for Canadian botany.

In many ways a strong research potential in botanical sciences will be of major importance in the future development of this great land area of the earth's surface. The emphasis on reductionist biology of the fifties is currently being diminished more and more in favor of environmental and evolutionary biology which are closer, for the most part, to the needs of man and his relationship to his surroundings. Complex ideas represented by such phrases as we read in this book — "unfavorable conditions," "favored habitats," "closed associations," "relict distributions," "temporary habitats," and so on — what do they really mean? Will such biological problems ever be placed upon a predictive and quantitative scientific basis? It is only by such efforts as are represented by the contributors to this volume that we can come closer to understanding the evolutionary and populational levels of the study of plants.

Marcel Raymond's "Personal Recollections of Frère Marie-Victorin" is a delightful introductory chapter which brings out the romantic character of the man and, along the way, a rich picture of his world. The subsequent chapters are more-or-less brief reviews of certain aspects of the flora, some of them containing original data. Robert K. S. Lee describes the marine benthic communities on Vancouver Island, and J. C. Ritchie the late Pleistocene history of the Canadian flora. For me the chapter that was most enjoyable to read was Jacques Rousseau's on "Movement of Plants." I was slightly confused by the title. As a long-time elementary botany teacher, used to the jargon of the trade, I tend to think of "movement" in connection with such things as turgor, tropism, taxis, etc. Rousseau is really discussing *changes* in plant species and communities together with their *migrations*. His lively style of writing and the helpful enumeration of examples (over 70 taxa, including animals), these well tied in with history, make this essay a very practical source of information.

Howard Crum's thoughtful contribution on evolutionary and geographic patterns in the Canadian moss flora points up our lack of knowledge. He admits that "Very little is known about the evolution of bryophytes, in Canada or elsewhere." I was very pleased, as a student of another group of spore-dispersing plants, the pteridophytes, to read Dr. Crum's comments on the assumption commonly made by phanerogamic botanists that "Spore-bearing plants are diffusely and ubiquitously distributed." The fact is, as he emphasizes, the spore-dispersed plants are dis-

tributed in nearly the same patterns with like relationships to the factors of geography and the environment, as the seed-dispersed plants.

The discussion on phytogeographic zonation by J. S. Rowe contrasts the floristic with the vegetational geography of Canada, bringing together the relationships of species to formations, migrations, fire, climate, and land-form in an admirably concise and readable format.

The largest chapter, and perhaps the most important one, is that by Theodore Mosquin on "Reproductive Specialization as a Factor in the Evolution of the Canadian Flora." It presents a good summary of current thinking about breeding systems, together with a pertinent bibliography which should be of value to readers in general. He proposes a new hypothesis, namely that specializations which foster genetic uniformity of populations have played the dominant role in the adaptation and evolution of the Canadian flora. The ancestors came from the lower latitudes, according to his argument, which may be summarized in the statement "Many Canadian species and genera are conservative and relatively static in evolution because they have for the most part lost the dynamic qualities of ideal diploid hermaphrodites." The evidence which Mosquin presents for his hypothesis in this stimulating paper is substantial. However, the question remains – why should mechanisms promoting constancy be adaptive? Is it really due, as he suggests, to "recurrent restrictiveness of northern climate," or "low soil and air temperatures during the growing season"?

Taylor A. Steeves, R. T. Coupland, and M. V. S. Raju follow up one aspect of Mosquin's paper in their chapter on "Vegetative Propagation in Relation to the Aggressiveness of Species." Interest in this subject has been steadily increasing in recent years. In the past the underground vegetative reproduction of plants has been largely an ignored phenomenon. It leads to difficult semantic questions; for example, what is an individual plant? The chapter shows correctly that vegetative multiplication must be considered in attempting to understand the composition of a flora. Although we still have but little knowledge of the subject, there seems to be no question that this type of reproduction is a matter of considerable importance and definitely calls for much more investigation.

Small though it is, this volume contains a rewarding concentration of useful information and ideas of value not only for classroom students of botany, for the researchers as well.

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Of Scientists and Salamanders

By VICTOR C. TWITTY. W. H. Freeman and Company, San Francisco. 1966. 178 pp. Illustrated. $4.50 (U.S.).

Victor Twitty ends his account of his intellectual odyssey as a scientist with a chapter entitled "Redemption or Downfall". The journey of which he writes takes a course which one would judge to be unusual among the intellectual travels of biologists in that it begins in the experimental laboratory, where it remains for many years, but from which it departs to the scene of current adventures in the stream valleys of the California coast ranges. Intellectual travel in a reverse direction, from natural history to experimentalism, is, one is led to believe, the time-honoured pathway of scientific autobiography. The fact that Dr. Twitty, who has made a great success of his route, did feel it necessary to end this little book with a defence, is probably proof enough that his history is unusual and that he has found many of

his peers critical of this particular pattern of behaviour.

For this reader, at least, it seems that no defence ought to be needed. For a scientist to follow the promptings of his curiosity and the questions raised by his material, whether they lead from field to laboratory, or the reverse, is always a respectable course of action. One function of Dr. Twitty's account of his experiences in the early, and spectacularly successful, days of experimental embryology, and his current preoccupation with the behaviour of California newts in the misty winter valleys of the coast ranges, may be to light a few sparks of tolerance and enlightenment among the currently haughty molecular specialists.

If there are lessons here for the laboratory biologist, there are important messages, too, for those who consider themselves ecologists and naturalists. Quite clearly, a laboratory scientist has come into their domain and been spectacularly successful. The qualities which have made Victor Twitty's work so successful have been imagination, a willingness to plan and carry through arduous experiments in the field, and persistent concentration on a related group of problems over a long period. These particular qualities are too often lacking among naturalists and ecologists, who tend to be diletantes in their research and thus to ignore, or fail to solve, some of the most interesting and significant problems which exist in nature. For this reason alone, I would recommend "Of Scientists and Salamanders" to both field and laboratory biologists, for the odyssey from the laboratories of Yale and Berlin to the winter waters of Pepperwood Creek ends as all good odysseys should, with unsolved problems.

There are some minor disappointments. There are a few typographical errors, and while Dr. Twitty's motivation is clear, I cannot be in sympathy with the liberties taken with the spelling of "*Ambystoma*" or the device of changing the nomenclature of the genus *Taricha* through the text in accordance with the peripatetic history that it has recently undergone. I found, also, that the account of the early experimental work dragged, in comparison with the more recent studies in the field. I doubt that this is a reflection of my own bias towards interest in Dr. Twitty's current studies and would attribute it rather to the difficulty of making the rationale of the early studies comprehensible to the non-embryologist for whom the material was intended. As implied above, however, these criticisms do not deter me from recommending this book to professional biologists, graduate students, and amateur naturalists.

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Interactions of Man and His Environment

Edited by BURGESS H. JENNINGS and JOHN E. MURPHY. Plenum Press, New York, 1966. 168 pp. $9.50.

The book presents in an attractive form the proceedings of the Northwestern University Conference of January 28-29, 1966, which was co-sponsored by the Borg-Warner Corporation and the University. Papers were presented by representatives of university, industry and government. These agencies are interested, particularly, in man's relation to his urban environment and the type of co-operative effort which offers a solution to some of the problems of air, water and other environmental pollution which man faces there. The first paper, by the Surgeon General of the United States, set the tone of the meeting with the title "Environmental Health, Everybody's Business".

Three sentences from the Foreword indicate something of the history and importance of the problem.

"Since the days when prehistoric man huddled in his cave, irritated by the smoke from his flickering fire, environmental control has challenged man. Even as the caveman had to endure smoke while he worked to improve his environment, so modern man has continued to complicate his situation by adding pollutants to the atmosphere and to water supplies. Nature with its largesse has given us enormous amounts of air and water, and yet the availability of uncontaminated air and water for growing population needs has become a real problem in many parts of the world."

Each of the 18 papers contributes new knowledge to the discussion and new food for thought. The subjects range from air and water pollution and the need for their control through noise and its control to the difference between radiant health and malaise or worse caused by a hostile environment that man has created through his "progress". Increase in short-term death rates through severe air pollution is documented as is auditory damage by excessive noise. The increasing chemical complexity of the atmosphere, which we all must breathe, is considered as an increasing menace to public health. "It is well known that man possesses an amazing ability to adapt to changes in his intake and surroundings, provided such variations occur slowly. But ecologically speaking, the chemical environment has been an explosive development. Since a large sector of the population is already believed to be maladapted to various environmental chemicals, what may be expected of a future which promises greater concentrations of present materials plus many additional ones? . . ."

"Such maladapted stages of chronic reactions may persist for many months or years, as long as accustomed routines are continued. Indeed, life tends to become something to be endured in sick boredom instead of a challenging and exhilarating experience."

The final speaker concluded: "It has been pointed out in the course of this conference that the people and government at all levels must make up their collective minds for corrective action now."

That conclusion is one with which we must all agree.

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Fishes of the Atlantic Coast of Canada

By A. H. Leim and W. B. Scott. Bulletin of the Fisheries Research Board of Canada (155): 1-485, 4 colour plates, 9 text-fig. incl. 2 charts, 224 species figures, 20 distribution maps. Queen's Printer, Ottawa. 1966 [1967] $8.50.

This work, by the late Dr. Leim and by Dr. Scott, is an important contribution to the ichthyology of the Atlantic coast of Canada. It covers those fishes known between Cape Chidley, northern Labrador and the southern tip of Grand Manan Island, New Brunswick and seaward to the 1000 fathom bathy contour.

Although there has long been Clemens and Wilby's *Fishes of the Pacific Coast of Canada* for the west coast, there has been no corresponding handbook for the east coast. Further studies, it may be noted, are being written on the fishes of the Arctic coast and of freshwaters of Canada.

The contents may be briefly sketched The book begins with a foreward by Dr. J. L. Hart outlining the development of the book. The introduction contains a historical review, a useful summary of oceanography of the area with charts of the currents and geographic features, and sections on classification, anatomy and format. Keys are presented to the larger groups and to species. The page numbers

given following the species or other taxa facilitates turning to the description. Since the keys provided are basically the same as those in Scott and Scott (1965) which I previously reviewed (1966, Canadian Field-Naturalist 80 (1): 57-58) further comments will not be made on them. Following the family and species accounts are a glossary of technical terms, a full index and space for notes.

Most species are dealt with in an excellent standard format. Above are the English and French common names and the scientific name. The spelling of the scientific names has obviously been carefully checked. Lead-headings facilitate the location of information in the paragraphs — Other common names, Description, Colour, Distinctions, Size, Range, Canadian distribution, Biology and Economics. The inclusion of the world range and French common names is an advance over *Fishes of the Pacific Coast of Canada*. The style is less technical than in the latter. Many species accounts list a single body part ratio instead of a range. Total length, instead of standard length, is used in ratios of body parts. The inclusion of distribution maps for some species is a good feature. Some families lack descriptions and some species appear only in the keys or are represented by abbreviated accounts. One hopes these will be completed in the next edition. Within the famiy, species are listed in alphabetical order. This sometimes results in related genera being placed far apart, making it difficult to compare them. The classification used is conservative, following C. T. Regan.

Although dated 1966 the volume did not appear until 1967. No references beyond 1964 were noted and those for 1963 were incomplete. Legendre's (1961) paper on *Gadus ogac* was omitted. Delay in publication has had some effect on currency of the text — on names and records. The foreward suggests the possibility of an early revision.

Three-quarters of the species are illustrated. The stippled drawing style employed is capable of giving superior rendition of detail. A certain unevenness results from their being drawn by several artists or from previously published sources. The differing styles and stances of fins, mouths etc. will make comparisons with specimens difficult in some cases. While some drawings are of high quality — the smelt, Arctic shanny, thorny skate and blue whiting, others are technically deficient — the banded killfish and fourhorn sculpin. Features of some drawings do not correspond with the text.

The binding, typography and editing are at the usual high level for board publications. Reproduction of figures is excellent save for a few drawings like the oilfish copied from other sources. The use of small type for Canadian distribution is disconcerting as it has the effect of breaking up the species account. The glossy paper is hard on the eyes and sticks together when wet. The colour plates, particularly the elegant one of the redfish add to the appearance of the book.

Fishes of the Atlantic coast of Canada will be a very useful publication for those interested in the fishes of our east coast.

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Silvics of Forest Trees of the United States

(Compiled and revised by H. A. FOWELLS). Agriculture Handbook No. 271. Forest Service, U.S. Department of Agriculture, Washington, D.C. 1965. 762 pp. $4.25.

An up-to-date comprehensive summary of silvical information composed of edited versions of 127 silvical leaflets most of which have been released as separates by the U.S. Forest Service. This book of 762 pages will provide a ready reference for teaching and research covering the distribution, life histories and responses to the environment of the

most important forest tree species in the United States. Also included with each is an extensive bibliography of literature on that species. Not all species native to the United States and Canada are included; however, all of the commercially important species are described.

The species of economic importance are essentially the same in Canada, so this book will be a valuable reference work for foresters, botanists, horticulturists and naturalists in Canada. Of special note are the detailed distribution maps which pinpoint most disjunct populations as well as the main areas for each species. Northern limits in Canada of many species are still not exact, and it is hoped that the new edition of Native Trees of Canada will have more exact northern limits of tree species where these are known. Between the two books we should have a fairly exact picture of the natural distribution of our more important forest trees. It is to be hoped that botanists, horticulturists etc. will note these and remove from future literature the many old inaccurate distribution records which have been carried along through the years. Also of note to northern horticulturists will be the extremes of temperature some of the species are exposed to in their areas of natural distribution. Selections from these colder extremes may prove useful in extending northward the cultural range of many of our native species of trees. The descriptions of root growth will be of interest to horticulturists and arborists.

The trees are listed alphabetically by genus; the species within a genus, however, are treated alphabetically by common name necessitating a search of the index unless one knows and is using the same common name as the book. Overall a valuable book. Let us hope that we soon have a companion volume for Canada.

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Geology Illustrated

By JOHN S. SHELTON. W. H. Freeman and Co., San Francisco. 1966. 11 x 8½ inches, 434 pp., 382 illustrations. $10.00.

This book will be welcomed not only by professional geologists but by others who take an interest in the subject especially since the volume contains many large and clear aerial photographs. The author, is a geologist, a teacher, and a photographer. He graduated from Pomona College, Claremont, California, and later gained his doctorate in geology at Yale University. In 1939 he started flying and became interested in photographing geological forms and structures. During the 1940's, he was associated with the United States Geological Survey. He also taught at Pomona, remaining there for 14 years. Since 1960, he has been Chief Scientific Advisor to the Elementary Earth Science Program of the American Geological Institute and Encyclopaedia Britannica Films, Inc.

The text of the volume is covered in six major parts.

I. Materials. A brief look at the rocks that compose the accessible part of the earth's crust.

II. Structure. The geometry of rock bodies, including the effects of bending and breaking by forces within the crust.

III. Sculpture. The ways the exposed parts of the earth's rocky structures have been carved and modified by surface processes to give to the landscape the shapes we see.

IV. Time. How geologic events can be arranged in chronological order and some insight into the magnitude of geologic time.

V. Case Histories. Examples of how a knowledge of geological principles may be used to decipher the record of past events and thus to read earth's autobiography.

VI. Implications. Some facts and speculation bearing on the deeper prob-

lems raised by observations at the earth's surface.

The author's geological work in the American West and Southwest enabled him to obtain wonderful aerial views of the landscape. He also photographed from the air in other parts of the United States and also in parts of Europe and the near East. The diagrams were drawn by the author's brother, Hal Shelton.

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The Glory of the Tree

By B. K. BOOM and H. KLIYN (colour illustrations by G. D. SWANENBURG de VEYE). Doubleday and Company Inc., New York. Translation from Dutch. First American edition. 1966. 128 pp., 194 colour plates. $15.00.

Here is an engaging and beautifully illustrated book about the trees that are commonly planted in the towns and cities, botanical gardens and arboreta, of western Europe. Fortunately, many of the same species are also used on our streets and in our parks, and the book can be recommended to all North Americans who want to know more about trees encountered in the urban environment. Though not intended as a handbook, botanical descriptions and interesting notes on several hundreds of different species and varieties are included. Fully one third of the pages are devoted to colour pictures of high quality and artistic merit, showing the appearances of the most important trees as well as some of their detailed features. About sixty line drawings of leaves, flowers and fruits assist in distinguishing between similar species.

A short first section introduces the reader to trees in their variety, telling something of how they grow and of the characters that make them desirable or undesirable for planting. Next in the body of the book follow descriptions of the trees in taxonomic order, conifers and broad-leaved species, with the excellent pictures interspersed. Appended are listings of the major botanical gardens of North America and Europe, of postage stamps that feature trees, of other recommended tree books, and a glossary of the meanings of the latinized species' names.

The book is a translation from the Dutch, but it does not seem to have suffered in style or imagery. In addition to good technical information on nomenclature and on distinctive features of the trees, there are abundant and fascinating notes on their histories, native habitats, folk lore and uses. For example, of the first tree in the book, the Ginkgo or Maidenhair Tree (*Ginkgo biloba*) the authors remark on its distinctive characteristics, its freedom from disease, the probability that it was saved from extinction by man although it can still be found growing wild in eastern China, the derivation of its name by transliteration of "yin hsing" or silver apricot (referring to the silvery sheen of the edible seeds), its reputed effectiveness in the Orient to turn away fire, and Goethe's pondering on its mystery in a short poem. There is also a humorous touch with reference to the tenaciously held opinion of some that it is possible to distinguish male and female Ginkgos by external characteristics; "a statement that is heard more especially over cocktails after botanical conferences."

One reads also that birch sap was once reputed to make a person beautiful and strong, but in time it came to be used as an alcoholic drink and, in Holland today, as a popular form of shampoo. There is the story of the Weeping Willow (misnamed *babylonica* by Linnaeus on the assumption that on its branches the psalmists hung their harps by the rivers of Babylon), symbol of unlucky love and sorrow. Fortunately the willows are a source of salycin, the essential ingredient of headache pills. Xerxes, we learn, lost a campaign because in his delight on first discovering Plane trees (sycamores) "he

forgot everything else and spent his time decorating the trunks with gold and jewels".

Professor Edgar T. Wherry assisted in editing the translation, and when he opines on the dust cover that the book "is a must for the library of every tree enthusiast", this reviewer is inclined to agree.

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Whooping Crane Population Dynamics on the Nesting Grounds, Wood Buffalo National Park, Northwest Territories, Canada.

By N. S. NOVAKOWSKI. Canadian Wildlife Service Report Series, No. 1. Queen's Printer, Ottawa. 1966. 16 photographs, 5 tables, 2 maps, 20 pp. $.50.

The first of this series of the Canadian Wildlife Service publications, on the whooping crane (*Grus americana*), is a fitting subject and Nick Novakowski, who has flown for 10 of the 12 summers regularly over the nesting grounds, is the logical author and he has done an excellent job.

The known breeding distribution today is along the Sass (where this study was made) and the Klewi rivers, Wood Buffalo National Park, Canada. By Ekman dredge samples made from the helicopter, in the feeding potholes, it was found that the pH of favorite ponds was 7.6-8.3, unused ponds, 7.2-7.3 and food items available, naiads of dragon-fly, larvae of caddis-fly, chironomid and mayfly, and the amphipod *Hyalella aztica* and others, probably used less often, several snails, the wheel snail and pill clam.

From temperature and precipitation records he concluded that during drier summers the whooping crane had better survival of chicks. Thirty-two of 40 hatched, survived until fall departure from 72 eggs (44.4%) but during the 12 year study, 36 adults and 9 young have been lost. However, the original 24 birds of 1954 has advanced to 38 in September 1966. The breeding adult population is nearly the same in 1966 as in 1954. But there were years when pairs disappeared, new ones reappearing later years, and one year, 1962, he found no indication of nesting at all. Four nests were found in 1955 and five in 1964 and 1965. Yet 29 other chicks were raised in some unknown region indicating an almost equal breeding population, a total of ten to 12 breeding pairs in all. Forty-six actual nests or parents with downy chicks were observed. All were built in shallow water, of and amongst rushes (*Scirpus validus*), contained two eggs, and placed back away from spruces.

Because of the high loss of birds, when parents leave them the first spring, and later, Novakowski considers the prognosis of the species as poor. I feel he is right but an increase from 24 to 38 birds in 12 years, could in another 25 years, with favourable conditions and breeding solitudes available, produce a substantial population. Both other white cranes by protection have increased considerably during recent years.

We thank the Canadian Wildlife Service for their fine work on this species and for bringing out this worth-while attractive publication.

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North American Birds Eggs

By CHESTER A. REED. Revised edition 1965. General Publishing Co., Don Mills, Toronto. 51 plates, 566 photos of eggs. xii + 372 pp. Paperbound $3.45.

This book was first published in 1904 and has long been out of print. It has now been reprinted, with considerable revision, by Dover Publications. For each

species there is a life-sized photograph of a single egg and a brief description of the egg color, shell texture, average dimensions, and clutch size. Usually there is a little information on the appearance of the bird itself and its habits. Many photographs of nests and eggs in the field are included.

In the reprint, pagination of the main text is the same as the original. However, nomenclature has been completely updated although the old species sequence (grebes to thrushes) remains. There is a good index.

There has been also some revision of the ranges by means of footnote corrections. In some places, however, further revision is desirable for some serious anomalies are apparent even in spot checking. For example, in Reed's time the nesting of the Solitary Sandpiper was poorly known. The data given for the egg photographed to illustrate the eggs of that species tell us that it was collected at Kingston, Ontario (now known to be far south of the breeding range) from a nest on the ground (the species nests in trees)! This should have been corrected. Editorial footnotes (pp. 120 and 121) say that the Greater and Lesser Yellowlegs and the Solitary Sandpiper nest only in northern Canada (actually they breed in central and parts of southern Canada, northern Canada being arctic!). Again, a footnote says, correctly (p. 30), that the Slaty-backed Gull does not breed in North America, yet the text still states that the egg shown was collected in Northwest Territories, Canada!

For most species, however, the information on nests and eggs is as good as it was in Reed's time. Anyone expecting to use it as a guide to accurate identification of egg collections, however, will probably be disappointed because a large proportion of North American bird eggs simply cannot be identified from the information furnished. Nor is the book designed to encourage people to collect bird eggs because, in addition to being most undesirable, the taking or possession of North American bird eggs is also illegal. The book was written as a guide for use by those requiring elementary information on the nesting of our birds.

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A Guide to Nature Projects

By TED S. PETIT. W. W. Norton Company Inc., N.Y. 316 pp. Illustrated. $4.95.

This book has been written for young people and the author is ably equipped for this task. As a naturalist and former editor of the Audubon magazine and as the present Director of Conservation for the National Council of the Boy Scouts of America, the author has been able to draw on a wealth of practical activities and knowledge which he knows has great attraction for young creative minds.

As children are naturally interested in their world about them, this book provides both direction and fundamental information. It is written at a reading age of between ten and sixteen years.

In the first few chapters, the author attempts to show the readers that they are not just surrounded by but are a part of the eternal processes of life.

Each of the succeeding chapters of "A Guide to Nature Projects" deals with a major aspect of nature such as water, soil, geology, plants and animals.

First, the reader is given a summary of background and reference material on each subject area and is then exposed to a series of activities and projects which the author has found by experience to be appealing to young children.

An important feature of the projects suggested is that they require only simple material and supplies that are found in or around most homes.

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Centennial of Entomology in Canada 1863-1963, A Tribute to Edmund M. Walker

Edited by GLENN B. WIGGINS. University of Toronto Press. 1966. 94 pp. 10 figures $5.00.

The Centennial of the Entomological Society of Canada was observed in 1963. This small book records briefly some of the events in celebration of this occasion, and more especially pays tribute to Edmund M. Walker, Professor Emeritus, University of Toronto. This tribute is very appropriate, since Professor Walker's life has encompassed much of the history of Canadian entomology, and his contributions to his science are outstanding.

Apart from the introductory chapter by the editor, and the address by G. P. Holland (on the history of organized entomology in Canada) that was delivered at the opening at the Royal Ontario Museum of a special exhibit to mark the Centennial, the book is devoted entirely to the life and work of Professor Walker. It takes the form of an autobiographical sketch and of chapters by colleagues and former students. The autobiographical sketch is a fascinating account of the growth of a scientist and of the science of entomology in Canada. It is followed by reminiscences by the late J. R. Dymond with reference to Professor Walker's career at the University of Toronto, by Glenn B. Wiggins concerning his work in the Royal Ontario Museum, and by J. G. Oughton entitled simply "impression of delight". Appraisals of his scientific contributions are provided by F. A. Urquhart (of work on the Orthoptera), by H. H. J. Nesbitt (on the discovery and studies of the famous *Grylloblatta campodeiformis*), and by Philip S. Corbet (of studies on Odonata). The chapters are all tastefully eulogistic and sparked with humour. A list of Dr. Walker's scientific publications is added.

Those who have known Professor Walker will certainly want a copy of this book, and those who want a light and delightful glimpse of the growth of Canadian entomology and of a man who contributed much to it will be pleased to have one in their library.

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The Wild Turkey, its History and Domestication

By A. W. SCHORGER. University of Oklahoma Press, Norman. 1966. 8vo, XIV. 625 pp., 1 colour plate, 48 illustrations, 20 figures and 34 tables. $12.50.

This splendid book is a reminder of the enormous debt owed by natural sciences, and especially natural history, to scholarly non-professionals. For years Dr. Schorger has made the collection of historical information on wildlife his field. At first we were treated to accounts of key species in his own state of Wisconsin. Then, with his book on the passenger pigeon, he broke into a broader field, in which he continues in this volume.

There are many good accounts of the wild turkey, but nothing quite so thorough as this, and nowhere else is each aspect of the biology of the turkey and the knowledge of it approached historically. One is especially grateful for the history of domestication, which is given in such a manner that it appears clearly that the natural history of domestic and wild birds is one story, not two.

From Ontario one might complain that the story of the wild turkey in our province is given no space at all. There is reference to Sandys' hunting stories, we are on the map, and there is an interesting reference that records that wild turkeys released in Scotland, with temporary success, were caught at Sarnia. That is all. Admittedly, the history of

our turkeys is important mainly to us, and the book is still invaluable.

A few years ago the wild turkey seemed to be a vanishing species. It had vanished already from many other areas as well as Ontario. In fact, when our records are compared with Dr. Schorger's, it is evident that it hung on longer in Ontario than in any adjacent state. One of the most gratifying results of scientific wildlife management in the United States is that it has been restored in most of the states where it once occurred, and established in a large area in the west where it was not found originally. The transition from vanishing to expanding and abundant shows that the decline of all wildlife is not irreversible. In Ontario, alas, there is no suitable area left — and in Manitoba there never was a suitable area, in spite of "gobblers unlimited!"

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Plants from Sea to Sea

By F. H. MONTGOMERY. The Ryerson Press, Toronto. 1966. 873 figures, 4 colour plates, 35 photos. 453 pp. $12.50.

This book is unique in that it attempts to identify the vascular plants of all Canada in an effort to aid both the amateur and the naturalist who are "constantly finding unfamiliar botanical material." The book starts on page 1 with a general key to plant families. This section is followed by detailed keys to the specific families: Equisetaceae (p. 39), Lycopodiaceae (p. 40), Selaginellaceae (p. 42), Ophioglossaceae and Osmundaceae (p. 43), Polypodiaceae (p. 45), Taxaceae and Pinaceae (p. 57), Dicotyledons (starting with Salicaceae, p. 62) and Monocotyledons (starting with Typhaceae, p. 357). Following the keys there is a brief bibliography (p. 413), a glossary (p. 415) and the index (pp. 419-453).

The book may be of considerable help to people who want to discover and identify 1,500 Canadian plants. There are good line drawings, most of them by Miss Joyce Hastilow, of 873 different species but though many of the figures show details of flower or fruit none gives any indication of the size of the plant. The keys give some information about the appearance of the plants, their habitat and distribution. The keys also give a common name and the scientific name of each species. Since there are, however, no descriptions of species, verification of identifications are possible only by looking at the drawings.

The book is apt to be a real disappointment when one starts to look at particular plant groups. First, I turned to the Cyperaceae (sedges) for they are a complex and very interesting part of our flora, and there are at least 150 species in Saskatchewan alone. I was amazed to find that the family was given less than one page of key and only 10 figures. The key separates 8 genera but does not attempt to key out any species. The Gramineae (grasses) are treated more adequately, for keys occupy 13½ pages and 51 species are illustrated by drawings. Serious amateurs will find even this treatment limiting, however. Our interesting native species of *Bromus* (Bromegrass) and *Agropyron* (Wheatgrass), for example, are mostly ignored. The 4 drawings which illustrate species of these two genera are all of introduced species.

Turning to the Leguminosae, I find that no species at all are mentioned in either *Astragalus* (Milk Vetches) or *Oxytropis* (Loco-weeds). These two genera are distinguished from others but this note is added: "Both these genera are difficult, even for the professional. Those interested should consult more technical texts." Such a statement limits the use of this book as the "authoritative guide" the publisher claims it to be.

With its simple keys and many clear illustrations, *Plants From Sea to Sea* may help a few people to discover some of the "wonders of nature" and if even a few of these are then compelled to consult the more technical books listed in the bibliography, it is useful. At the same time, the sparsity of information could result in the inaccurate identification of many plants by amateurs and naturalists alike.

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The Year Outdoors—A Naturalist's Calendar

By EVA RODIMER. Rutgers University Press, New Brunswick, New Jersey. 1966. Distributed by Ryerson Press, 299 Queen Street West, Toronto 2B. 294 pp. $7.75.

Observations made during Eva Rodimer's 50 years of nature rambles in Sussex County, New Jersey, form the basis of the book. Its 19 chapters cover the seasons from winter to winter and detail the changes in flora and fauna that accompany the changing seasons.

Mrs. Rodimer's powers of observation are excellent. She has recorded ecological detail that many would miss.

While her language is somewhat anthropomorphic, her biology is sound.

Fifty years as a school teacher have polished her writing to a smooth flow. Her style paints such vivid natural scenes that you are with her as she makes her observations. Mrs. Rodimer says:

"I wish to share these experiences of a lifetime with you. I want you to know and love the land as I do. If you follow nature you will find adventure, quiet beauty, and infinite peace. And in building an appreciation of the life of your environment there will come, I hope, a great desire to conserve our natural heritage for the study and the enjoyment of generations yet unborn."

The book should be read a little at a time. On days when a nature ramble is impossible, it will make a pleasant substitute.

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Living Island

By EVELYN M. RICHARDSON. Ryerson Press, Toronto. 1965. 216 pp. $4.95.

Evelyn Richardson's several non-fiction books, including her award-winning 'We Keep a Light', deal with her life as the wife of a lighthouse keeper on the small Nova Scotian island of Bon Portage. All are deservedly popular. 'Living Island', her latest, reveals her as an enthusiastic and competent bird watcher.

Mrs. Richardson is a discerning, painstaking, and sensitive observer gifted with the ability to see clearly much that others only half see or miss completely. She writes vividly. She shows us through the thrilling procession of spring and autumn bird migrations, songful and bustling nesting seasons, and through the quiet of winter. There are winter storms, memorable summer days, sombre fogs, autumn colors, and always the sounds of the sea. In the ten year period covered by the book, the author and Bon Portage Island turned up an impressive number of records of casual or accidental species of birds most of which have been accepted in the ornithological literature of Nova Scotia. The author's accounts in this book of many of these avian waifs make intriguing reading.

Although the book will be enjoyed by just about anyone, it has an especial appeal for bird watchers who are sure to find themselves constantly comparing Mrs. Richardson's impressions of the birds with their own.

W. EARL GODFREY

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Dinosaur Hunting in Western Canada

By LORIS S. RUSSELL. 1966. Royal Ontario Museum, Life Science Series, Contribution 70, 37 pages, 16 illustrations. Paperback. -1.00.

During the concluding phases of the age of reptiles, between 90 and 63 million years ago, most of the area now included in the prairie provinces was covered by a wide subtropical sea. Sediments from the ancestral Rockies to the west formed a belt of low alluvial plains separating the mountains from the sea. These sediments buried and preserved skeletal remains of numerous varieties of dinosaurs.

Russell describes the history of dinosaur collecting in these "fossil floodplain" deposits, from their discovery in 1873 by the North American Boundary Commission up to 1965. By 1889 geologists had located nearly all of the subsequently important localities, but large scale excavation of articulated skeletal remains did not begin until 1910 when Barnum Brown of the American Museum of Natural History began collecting on the Red Deer River. Brown's spectacular success prompted the Geological Survey of Canada to appoint C. H. Sternberg and his three sons, all veteran fossil collectors, to compete with Brown and make collections for the Survey. From 1912 through 1915 parties led by these two men worked separately in the badlands along the Red Deer River, warily keeping an eye on each other's progress, and working strenuously, sending tons of bones of previously unknown kinds of dinosaurs back to their home institutions. Brown left Alberta at the close of the 1915 season, but the Geological Survey (later the National Museum), and the Royal Ontario Museum from 1918 on, continued to collect dinosaurs on the Red Deer and elsewhere in western Canada.

The paper gives a concise chronological account of collecting activities, together with interesting biographical sketches of the individual collectors. Photographs illustrating the text show the men in their camps or with partially excavated specimens, and are especially well-chosen. The author was writing primarily for students of vertebrate palaeontology, but a brief description of the geologic setting will enable many westerners to appreciate the geological as well as the historical significance of the dinosaur localities near their homes. Generic names of the more important specimens discovered in the course of each expedition have been included, but it was not the author's intention to describe the form and possible habits of any dinosaur. This paper, written by a distinguished Canadian vertebrate palaeontologist, fills a large gap in the literature bearing on one of the world's most important dinosaur collecting areas.

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Non Flowering Plants

By FLOYD S. SHUTTLEWORTH and HERBERT S. ZIM. A Golden Nature Guide. Golden Press, New York. 160 pp. $1.00.

A well-presented introduction to some common plants among the algae, fungi, lichens, mosses, ferns and others. Briefly treated are evolution and group relationships, distribution and habitat. A simple outline of reproduction, common characteristics and economic importance of each group is followed by species' descriptions illustrated in full colour by accurate and attractive small paintings, more than 400 in all. Activities are suggested for interested readers.

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OTHER NEW TITLES

A Comparative Life-history Study of Four Species of Woodpeckers.

By LOUISE de KIRILINE LAWRENCE. 1966. Ornithological Monographs No. 5. The American Ornithologist's Union. Illustrated – 156 pp. Printed by Allen Press Inc., Lawrence, Kansas, $3.75 (US).

This investigation into the behavior of wild woodpeckers was made at Pimisi Bay (lat. 46° 16", N) in central Ontario. The study was based on seven years of intensive observations, 1953 through 1959, and includes banding data as well as daily records of the past 25 years. Species studied were the Yellow-bellied Sapsucker, the Yellow-shafted Flicker, the Hairy Woodpecker and the Downy Woodpecker.

Summary, Notes and Papers of the Thirtieth Federal-Provincial Wildlife Conference, 1966. 66 pp. The Canadian Wildlife Service, Department of Indian Affairs and Northern Development, Ottawa.

This booklet contains the following sections: (1) A report on recommendations presented by the 29th Federal-Provincial Wildlife Conference. (2) Agenda of the 30th Conference (3) Summary notes on the 30th Conference, and (4) list of registrants. Full texts of the following papers are given:

1. Birds of prey and the practice of falconry in Canada – R. W. Fyfe.
2. National Pollution Conference – C. de Laet.
3. Waterfowl losses and ways to reduce them – Dr. V. E. F. Solman.
4. Acceptability of agreements for rental of rights to Basins – Dr. W. J. D. Stephen.
5. Enforcement of Migratory Birds Convention Act – A. T. Pelletier.
6. A highlight report on some recent fish and wildlife matters in the United States – Dr. Noble Buell.

Vegetation and Common Plants of Sleeping Bear

By PAUL W. THOMPSON, 1967. Cranbrook Institute of Science Bulletin 52. The Cranbrook Press, Michigan. Designed by Richard Kinney, Edited by Margaret C. Fletcher. Illustrated – 47 pp. $1.50 (U.S.).

The Sleeping Bear region is located in Leelanau County, on the eastern shore of Lake Michigan and includes a mosaic of natural vegetation types including extensive sand dune areas. It contains a small ancient forest of White Cedars. One tree has a height of 110 feet, a girth of 206 inches, and is the largest known specimen of this species. The trees are about 500 years old. Parts of the region including two islands have recently been included in the Sleeping Bear Dunes National Lakeshore.

Forest Recreation Research: Bibliography of Forest Service, Outdoor Recreation. Research Publications, 1942 through 1966. U.S. Department of Agriculture, Forest Service, 1967. 15 pp.

Conservation Directory 1967.

1412 16th Street, N.W. Washington, D.C. 20036. 121 pp. $1.00 (U.S.). A listing of organizations, agencies and officials concerned with natural resources use and management. This is the 12th consecutive edition of the Conservation Directory, published as an educational service of the National Wildlife Federation. It lists personnel and officers of most governmental agencies and citizen organizations concerned with aspects of natural resource use and management. In addition to the United States and Canadian entries, there are listings of organizations having worldwide interests in natural history and conservation.

NOTES

Sex Ratios and Wing Chord Lengths of Pine Siskins (*Spinus pinus*) in Algonquin Park, Ontario

Captures of individuals of certain species of birds during periodic invasions of them can provide some basic information about these species. During the winter of 1960-61, large numbers of Pine Siskins as well as both Red and White-winged Crossbills were evident throughout a greater part of Ontario. Between May 4 and May 9, 1961, 371 Pine Siskins were caught and banded at the Department of Lands and Forests Wildlife Research Station in Algonquin Park, Ontario. This paper reports on the sex ratios among these birds as well as wing chord lengths of males and females.

On May 3, several flocks of Pine Siskins, together with a few individuals of both species of crossbills, were evident in the area of the Research Station. Large numbers of these birds, particularly siskins, were attracted to calcium encrustations on the face of a concrete retaining wall on two sides of an elevated parking lot. This wall varied from four to seven feet in height, and was approximately 150 feet long.

Two Japanese mist nets, each 40 feet long, were placed parallel to the wall, and one or two feet from it, to catch the birds. The nets were set wherever the birds were in greatest concentrations, and were moved as the activity of the birds shifted. Trapping was discontinued on May 9 following a mass exodus of the population.

The nets were checked every half hour or less during the daylight hours. Birds were removed from the nets, placed in collecting boxes, and taken to the laboratory for measurement, sexing, and banding. Wing chord lengths were measured with a thin celluloid ruler placed under the wing. Sex was determined by the cloacal protuberance method (Wolfson, 1952).

Because no bird was retrapped in the net in which it was caught originally, although it could be caught again in the second net or in the first net in a new position, it was assumed that the trapping method influenced the number of recaptures. Thus these data could not be used to calculate sizes of flocks (nor to determine the integrity of each flock.)

Sex Ratios

Sex ratios in daily and total catches are shown in Table I. Daily catches suggest a gradual reduction in the proportion of males to females from a ratio of 230:100 to 100:100, although the highest ratio of 280:100 was recorded on the second day. The sex ratio of the total catch was 190:100 males to females.

These ratios could indicate the true proportions of the sexes in the flocks at this time. There was a gradual reduction in the populations of siskins in the general area during the period of trapping, and by May 9 only occasional pairs or small flocks were seen. Therefore, in these migrating flocks, there may be more males than females, but males could depart before females. This greater reduction of males is suggested in the shift, although uneven, from a ratio of 230:100 down to one of 100:100 males to females during the trapping period.

There is at least one alternative explanation. The higher proportion of males in the catches could indicate a behavioural difference between the sexes in the attractiveness of the calcium deposits on the concrete. During the period of activity about the wall, flocks approaching the area alighted in tall spruce trees near the wall. Although it was difficult to keep track of all the birds in

TABLE 1.—Numbers and proportions of male and female Pine Siskins in the daily catches and total catch during the trapping period from May 4 to May 8, 1961.

Date	Numbers		Ratio (males:females)
	Males	Females	
May 4	48	21	230:100
May 5	76	27	280:100
May 6	33	20	170:100
May 7	52	24	220:100
May 8	35	35	100:100
Total	244	127	190:100

these flocks at one time, it appeared as though only some of the birds would come down to the wall, and that others remained in the trees and seemed to feed there. Thus males could be attracted more to calcium, and females more to objects or substances found in the spruce trees. If so, then sex ratios within flocks might be more even than is indicated by the present data.

Both these explanations are speculative, and more information is needed before any conclusions can be drawn regarding sex ratios in populations of this species, and as to possible behavioural differences in the feeding activities between the sexes.

Wing Chord Measurements

Wing chords of 222 male and 113 female Pine Siskins were measured. The mean length and standard error of wing chords of males was 74.22 ± 0.09 mm, with a range in measurements from 71 to 80 mm. Those of females were 71.88 ± 0.14 mm, ranging from 68 to 75 mm. The mean values are significantly different. Thus, on the average, male Pine Siskins have longer wing chords than do females.

Although the mean values are significantly different, there is a large amount of overlap between the two sets of data. The only measurements free of overlap are those greater than 75 mm for males and those less than 71 mm for females. These two groups are represented in the sample by 36 of 222 males (16.2%) and 22 of 113 females (19.4%). Thus, despite differences between mean lengths, wing chord lengths are of limited value as an external means for determining the sex of Pine Siskins.

Acknowledgments

The data presented in this paper were collected incidental to other studies supported by grants to Dr. J. Bruce Falls, Department of Zoology, University of Toronto, from the National Research Council and the Advisory Committee on Scientific Research of the University of Toronto. Research facilities in Algonquin Park were provided by the Ontario Department of Lands and Forests, through the courtesy of Mr. Robin Hepburn.

Summary

The sex ratio among 371 Pine Siskins caught during a 5-day period in early May 1961 suggests that there were almost twice as many males as females. It is speculated that this high proportion of males could be produced either by differential migration of the sexes or by a greater attraction of males to calcium encrustations about which the birds were netted. Measurements of wing chords of 335 birds indicate that, on the average, males have longer wing chords than do females, but that the large amount of overlap in the ranges of these values for

the two sexes prevents the use of this measurement as an external means of sexing Pine Siskins.

REFERENCES

WOLFSON, A. 1952. The cloacal protuberance — a means of determining breeding conditions in live male passerines. Bird-Banding, 23: 159-165.

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An Overlooked Record of the Ruff in Quebec

IN A RECENT PAPER C. F. Leck (1966), reviewed the status of the Ruff, *Philomachus pugnax*, in eastern North America. However, one publication containing the only record of the species for the Province of Quebec, Canada, has been overlooked. A male in full plumage was shot at Seven Islands (Sept-Iles), Duplessis Co., on the North Shore of the Gulf of St. Lawrence, by a Montagnais Indian, on May 29, 1933, and became part of the collection of the late Dr. D. A. Déry (Anonymous, 1933; W. E. Godfrey, 1964). This record has also been overlooked in two important publications covering the area (F. Harper, 1958; W. E. C. Todd, 1963). The author has recently been unsuccessful in locating the specimen; the Déry collection was divided among several individuals and institutions some years ago.

REFERENCES

ANONYMOUS. 1933. Annual Report 1933. The Provancher Society of Canada. p. 15.

GODFREY, W. EARL. 1964. (Review of) Birds of the Labrador Peninsula and adjacent areas. Canadian Field-Naturalist 78 (2): 119-120.

HARPER, FRANCIS. 1958. Birds of the Ungava Peninsula. University of Kansas Miscellaneous Publication 17: 1-171.

LECK, CHARLES F. 1966. The history and status of the Ruff in eastern North America. Auk 83(3): 473-474.

TODD, W. E. CLYDE. 1963. Birds of the Labrador Peninsula and adjacent areas. University of Toronto Press, Toronto. 819 pp.

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Manitoba's First Collected Specimen of the Varied Thrush

A STRANGE SPECIES OF THRUSH, first seen frequenting a feeding area on the grounds of the Brandon Hospital for Mental Diseases in early November, 1965, was identified as a Varied Thrush, *Ixoreus naevius*, by J. Lane and R. K. Lane on December 26, 1965.

This wanderer from the far west was a part of a considerable invasion of the prairie Provinces and north-central United States by this species, in the fall of 1965. Brazier (1965) reported one, and perhaps two, of the birds present in Regina, Sask; Strubbe (1966) and Isaksen (1966) each recorded the species in Minnesota, late in 1965.

Following the positive identification of the Brandon bird, the three authors set up a camera blind at the feeding area on the morning of December 27. The thrush visited the spot several times that morning, although it failed to come in to camera range, and appeared to be suffering from the severe cold since the temperature the previous night had fallen to -25 degrees. We noted that the bird carried its left foot tucked up in the belly feathers, and when perching on a tree limb, it had difficulty in keeping a balance on the one leg.

On the morning of December 28 we once more set up the blind, and after one hesitant visit to the baited area, the thrush flew down into a gully and drank

from an overflowing spring, then flew to a small oak tree where he perched at a height of about eight feet. The bird failed to fly at our close approach, and when we were almost within camera range it suddenly dropped from the tree and expired as we lifted it from the snow. We found the nostrils completely frozen over with ice and snow, and believe suffocation may have been the cause of death.

This is the first specimen of *I. naevius* collected in Manitoba. The two junior authors (B. Peters and W. Miller) have made the bird in to a museum mount, and it is now in the "B. J. Hales Museum of Natural History" at Brandon University. We took the following statistics:

Length, 248 mm.
Wing, 129 mm.
Wingspread, 394 mm.
Weight, 72.13 grams
Sex, male
Skull, heavily ossified, indicating a fully-matured adult.

REFERENCES

BRAZIER, FRANK H. 1965. Varied Thrush Continues to visit Regina. Blue Jay, 23: 160.

STRUBBE, ERNEST H. 1966. Varied Thrush Seen in Morris. The Loon, 38: 34-35.

ISAKSEN, MRS. ELMER. 1966. Varied Thrush Seen Near Cushing. The Loon, 38: 35.

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Spotted Sandpiper Chicks Returning to the Nest:

THE PRECOCIAL HABIT of shorebird (Charadriformes) chicks deserting the nest soon after hatching is well documented. Therefore I consider it of interest to record the following observation on the Spotted Sandpiper, *Actitis macularia.*

At 2:00 p.m. on July 7, 1966, at our farm at Sayward, Vancouver Island, British Columbia, I flushed a Spotted Sandpiper from its nest in our oat field. There were four young in the nest which was a deep cup lined with fine grasses and hair. Three hours later I returned but the young had departed. Later that evening, at dusk, I returned with my sister to show her the nest and to my surprise all four young had returned. Next morning when I again checked the nest, at 10:00 a.m., one chick was still in the nest, one was a foot away, and the other two were not located. That evening my father checked the nest but the young had not returned.

Neither Tyler (*in* Bent, 1929) nor any of the following authors: Mousley, 1937 and 1939; Knowles 1942; Miller and Miller, 1948; Preston, 1951; mention the Spotted Sandpiper chicks returning to the nest after hatching.

REFERENCES

BENT, A. C. 1929. Life Histories of North American Shorebirds, Part II; 78-97, (Spotted Sandpiper, contributed by W. M. Tyler), U.S. Nat. Mus. Bull., 146.

KNOWLES, E. H. M. 1942. The Nesting Habits of the Spotted Sandpiper; Auk, 59: 583-584.

MILLER, J. R., and MILLER, T. J. 1948, Nesting of the Spotted Sandpiper at Detroit Michigan; Auk 65: 558-567.

MOUSLEY, H. 1937. Nesting Habits of the Spotted Sandpiper, Auk, 54: 445-451.

MOUSLEY, H. 1939. Nesting Behavior of Wilson's Snipe and Spotted Sandpiper; Auk, 56: 129-133.

PRESTON, F. W. 1951. Egg Laying, Incubation and Fledging Periods of the Spotted Sandpiper; Wilson Bulletin, 63: 43.

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Hedysarum occidentale Greene (*Leguminosae*), new to Canada[1]

Hedysarum occidentale GREENE WAS formerly recorded from the western parts of Montana, Wyoming, Colorado, central Idaho, and the Olympic Peninsula of western Washington. The type specimen was collected in the Olympic Mountains of Washington by C. V. Piper in 1890. Examination of herbarium specimens of *Hedysarum* collected by J. A. Calder and K. T. MacKay in 1961, revealed the presence of a population of *H. occidentale* in central interior Vancouver Island, British Columbia. This species has not been recorded previously for Canada by Taylor (1966), Hitchcock et al. (1961), Eastham (1947), Henry (1915) nor by Rollins (1940) who studied the North American species of the genus. The Calder collections represent a northwestern extension of range of this species of approximately one hundred and forty miles.

Rollins (1940) postulated a preglacial connection between the Olympic and Idaho populations of this species through British Columbia. Subsequently they became isolated by glaciation. He was unable to distinguish any significant morphological difference between these eastern and western populations. The occurrence of the population on Vancouver Island raises the question of whether or not this species was actually connected through British Columbia or whether the Olympic Peninsula population actually represents the remains of an arm of the Rocky Mountain population which has become isolated by climatic changes in Idaho, Oregon and Washington. It seems clear that the Vancouver Island population merely represents a northern portion of this coastal arm which has in turn become isolated from the Olympic Peninsula population.

Specimens examined: *BRITISH COLUMBIA*. Vancouver Island: Crest Mtn. on Gold River Road, 49°52'N, 125°52'W, rare on open rocky knolls in subalpine forest at about 4200', flowers pinkish, *Calder and MacKay 31595*, July 19, 1961; Golden Hinde above Burman Lake, 49° 40'N 125°45'W, common on slopes by creek just below treeline at about 4500 ft., flowers pink, *Calder and MacKay 32506A*, Aug. 15, 1961; Golden Hinde above Burman Lake, occasional on west-facing, sparsely vegetated slope in col at about 5700 ft., flowers pink, *Calder and MacKay 32506*, Aug. 15, 1961. These are deposited in the Plant Research Institute herbarium (DAO) at Ottawa.

REFERENCES

EASTHAM, J. W. 1947. Supplement to 'Flora of Southern British Columbia'. B.C. Prov. Mus. Spec. Pub. No. 1. p. 71-72. Victoria.

HENRY, J. K. 1915. Flora of southern British Columbia and Vancouver Island. p. 191-192. Toronto.

HITCHCOCK, C. L. et al. 1961. Vascular plants of the Pacific Northwest. Pt. 3. p. 275-278. Seattle.

ROLLINS, R. C. 1940. The genus *Hedysarum* in North America. Rhodora 42: 217-239.

TAYLOR, T. M. C. 1966. Vascular flora of British Columbia Preliminary check list. Processed. p. 20. Univ. B.C. Vancouver.

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An Albino Ring-billed Gull from Ontario

ON JULY 2, 1966, Mr. Alf Bunker captured an immature female Ring-billed Gull, *Larus delawarensis*, in a large colony at Gull Island, Presqu'ile, Northumberland County, Ontario. This bird (ROM 97786) was sacrificed by Ian Seddon, Park Naturalist, on 6 July 1966 and donated to the Royal Ontario

Museum. This individual was a true albino having completely white plumage, and the characteristically pink iris, feet, and legs. At the time of preparation, the specimen was heavy with fat and weighed 315.6 grams. Other measurements are as follows: wing (chord), 290.0 mm; tail, 116.1 mm; tarsus, 51.3 mm; bill (from nostril), 14.8 mm; culmen, 36.3 mm; gape, 15.2 mm; gony, 10.5 mm; depth of bill, 11.5 mm. This is the first record of albinism in this species in Ontario and only the second documentation known to me (*see* M. B. Trautman, 1933, Auk, 50:235).

Records of albino Herring Gulls, *Larus argentatus*, (A. O. Gross, 1964, Auk 81(4):551; W. P. Nickell, 1964, Auk 81(4):560, and Bonaparte's Gull, *Larus philadelphia*, (A. D. Cruickshank, 1940, Proceedings of the Linnaean Society of New York 50-51: 31-32) seem not to be rarities. However, collecting and preserving the specimen seems to be unusual or at least not mentioned in the published papers.

Sight records of "white" gulls, in North America need to be carefully scrutinized as it does not necessarily follow that the bird is an albino. For example, the Ivory Gull, *Pagophila alba*, is completely white and somewhat smaller than the common North American birds of the genus *Larus*. It is quite possible to mistake the Ivory Gull for an albino of another species, especially since accurate estimates of size can not be readily obtained at any distance. However, the Ivory Gull is apparently of rare occurrence in the United States (A. D. Cruickshank, *op. cit.*) and southern Ontario (J. H. Fleming, 1906, Auk: 23:442). Still the question arises as to how many white gulls are albinos and identified as another species.

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A note on the homing behaviour of *Peromyscus maniculatus osgoodi*

INDIVIDUAL *Peromyscus* trapped alive, transported various distances and released, frequently return to the original point of capture (Murie and Murie, 1931). Murie (1963), explained such behaviour as random wandering until reaching familiar territory. Kendeigh (1944), Griffo (1961) and Fisler (1966), suggest that homing results from knowledge of more terrain than the usual demonstrated home range. As success in homing decreases with the distance displaced, Griffo (1961) suggests that, as well as a home range, individual *Peromyscus* have a "life range" which he defines as "all the area an animal traverses during its lifetime".

An opportunity to experiment with homing was offered in a study of a *Peromyscus maniculatus* population near Saskatoon, Saskatchewan, Canada. The study plot consisted of a dense mixed stand of *Carex*, *Agropyron*, *Bromus* and *Stipa* with a closed canopy of *Symphoricarpos*, *Prunus*, *Rosa* and *Populus*. Trap stations were placed in 10 parallel lines 60 feet apart with 10 stations 60 feet apart on each line. All traps were opened and baited at 7 PM and checked at 6 AM of the following morning. Captured mice were removed from the traps, toe-clip number, age, sex and reproductive data were recorded, and the animals were released at the capture station. Moribund animals were removed from the traps, revived and released in the evening of the same day at the station of initial capture.

On the evening of 19 August 1966, one male *Peromyscus maniculatus* (sub-adult pelage) was inadvertently released at a station (no. 86) which was 490 feet from its point of capture at station 21 that morning. The following morning the animal was recaptured at station 21. To

determine whether that movement would be repeated, the transport from station 21 and release from station 86 was repeated on the evenings of 21 and 22 August. On 22 and 23 August the mouse was recaptured 60 feet from station 21. Minimum travel was 490 feet on the night of 19 August, 410 feet on 21 August and 420 feet on 22 August. As the mouse was released at 9 P.M. and removed from the trap at 7 A.M., travel time in each instance was less than 10 hrs.

Mean diameter of the trap-revealed home range of 14 male sub-adult *Peromyscus maniculatus* in this study was 300 feet. It is possible therefore that the mouse was returning to its home area from a point within its "life range". As all traps were opened and baited when the mouse was released in the homing experiment, it passed within 60 feet of at least 14 traps in each movement back to the station of recapture. The observed rate of travel (average 44 ft/hr) and lack of attention to traps far from station 21 suggest that movement was not entirely random. As the animal had not been fed prior to release, it would appear that feeding and unnecessary investigation were minimal until familiar territory was reached.

These observations were made in the course of other research being performed with the support of a grant from the Canadian Wildlife Service.

REFERENCES

FISLER, G. F. 1966. Homing in the western harvest mouse, *Reithrodontomys megalotis*. Journal of Mammalogy, 47: 53-58.

GRIFFO, J. V. JR. 1961. A study of homing in the cotton mouse, *Peromyscus gossypinus*. American Midland Naturalist, 65: 257-289.

KENDEIGH, S. C. 1944. Homing of *Peromyscus maniculatus gracilis*. Journal of Mammalogy, 25: 405-407.

MURIE, O. J. and ADOLPH MURIE. 1931. Travels of *Peromyscus*. Journal of Mammalogy, 12: 200-209.

MURIE, M. 1963. Homing and orientation of deermice. Journal of Mammalogy, 44: 338-349.

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Xanthochroism in the Cape May Warbler and Evening Grosbeak

G. D. SCHNELL AND L. D. CALDWELL (1966) recorded an instance of xanthochroism in the Cape May Warbler, *Dendroica tigrina*. They found no additional specimens showing this aberrancy among approximately 1,000 skins of the species in four large and several smaller United States museums.

Recently, the writer examined another Cape May Warbler exhibiting xanthochroism. This specimen was collected at Deschambault Lake, Saskatchewan, in spring, 1966. It is No. 10013 in the Saskatchewan Museum of Natural History and I am grateful to Mr. Victor Schmidt of that institution for permission to record it. Judging by its plumage the bird is a male. The back of the neck and the interscapular region are mostly yellow with a very few normal feathers. The rump is canary yellow. The yellow feathers of back and rump have white bases thus indicating that the aberrancy is a form of schizochroism, in which the melanic pigments are absent or deficient. Breast and sides appear normal superficially, but many of the feathers have white bases.

R. W. Tufts (1962) mentioned an abnormally colored male Evening Grosbeak, *Hesperiphona vespertina*, which he collected at Wolfville, Nova Scotia, on November 25, 1958. This was kindly donated by Dr. Tufts to the National Museum of Canada (catalogue number 42583).

It is a fine example of xanthochroism. The head and neck are canary yellow with a few black or partly black feathers in the crown. The back is yellow, much blotched with brownish olive, and becoming immaculate yellow on lower back, rump, and upper tail coverts (last are normally black). Primaries of right wing black, fading to white near tips (except second to outermost, which is all white). Four outer primaries of left wing white with traces of yellow on outer edges. Wing coverts mostly yellow, some black. A few primary coverts are white. The inner rectrices have various amounts of white. The under parts are yellow with an admixture of yellowish-olive feathers on the breast and upper abdomen. As in the aberrant Cape May Warbler mentioned above, the abnormal yellow feathers are white at their proximal ends.

A. O. Gross (1965) listed six examples of xanthochroism in North American birds but included no species of Parulidae. He cited two examples of this in the Evening Grosbeak including the bird here described. There is apparently yet a third published example of xanthochroism in the Evening Grosbeak, a female collected at Pullman, Washington, on January 1, 1933 and recorded and described by Arthur Svihla (1933).

REFERENCES

GROSS, A. O. 1965. Melanism in North American birds. Bird-Banding 36(4): 240-243.

SCHNELL, G. D. and L. D. CALDWELL. 1966. Xanthochroism in a Cape May Warbler. The Auk 83(4): 667-668.

SVIHLA, ARTHUR. 1933. An abnormally colored western Evening Grosbeak. The Auk 50(2): 224-225.

TUFTS, R. W. 1962. The birds of Nova Scotia. The Nova Scotia Museum, Halifax. 481 pp.

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Occurrence of ptarmigan off northern Labrador

IN THE COURSE OF A recent research cruise off the Labrador coast, the C.G.S. *A. T. Cameron* left the vicinity of Cape White Handkerchief (59°17'N, 63°23'W) at 1000 Nfld. Standard Time, October 9, 1966, steaming roughly ENE at 10 knots until arrival at position 59°45'N lat., 59°30'W long. at 2200 NST on the same day. The ship remained in this vicinity, about 120 miles from the nearest land, until 1700 NST October 10.

On the evening of October 9, I was informed by Mr. C. Pardy, First Mate of the *A. T. Cameron*, that a number of ptarmigan (*Lagopus* sp.) had been observed flying about the ship while steaming out from the coast. After dark on the same day a ptarmigan flew into an aerial and dropped to the deck, where it was picked up by a crew member. The ship was stopped for most of the next day and frequent observations of one or two ptarmigan were made. Periodically a bird would perch on the ship's rail, remaining until it was frightened off or captured by one of the crew. Four birds were captured by various crew members who crept up behind and picked them off the rail. Occasionally, as the ship made a sudden movement, a bird would fly a few feet straight up from the rail, remaining a few seconds in the air and alighting again.

Unfortunately no positive identification of species was made on board and no specimens were preserved. However, from previous reports of ptarmigan sighted over northern open water areas, it seems likely that these were Rock Ptarmigan (*Lagopus mutus*). Thus Todd (1963, Birds of the Labrador Peninsula and adjacent areas, Univ. Toronto Press, p. 272) summarizes a number of observations concerning northerly spring and southerly autumn migration of Rock Ptarmigan across Hudson Strait, including a description of birds perching on

the spars and rigging of a ship passing through the Strait. Of particular interest is the report by Gross (1937, Auk, 54: 12-42), from observations at Port Burwell (eastern end of Hudson Strait), that the peak autumn migration occurs about October 1-15.

Though the weather was calm during the period of observations, southwesterly gales occurred along the northern Labrador coast on October 8. This may account for the great distance offshore at which some of the birds were seen. It is also possible that birds may have perched unobserved on the ship during the evening of October 9, remaining overnight. The northern Labrador coast was snow-covered at the time and the birds had attained almost full winter plumage.

I am grateful to Dr. L. M. Tuck of the Canadian Wildlife Service for criticism and advice during the preparation of this note.

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Unusual Sight Records of Birds Near Churchill, Manitoba

ON JULY 4, 1966 a Lewis' Woodpecker *Asyndesmus lewis*, was seen two and one half miles south of Akudlik, the Eskimo village about mid-way between Churchill and Fort Churchill, Manitoba. First found by Dr. A. Keast of Queen's University, it was seen a few minutes later by Dr. J. B. Falls, W. E. Rees, and myself.

We easily saw its black back and grey collar as it perched on the top of a nearby spruce. When it was facing us, its red face and pink breast were obvious. It flew in the same manner as a flicker, whose size it approximated. One characteristic behavioral feature we noted was that on occasion it mounted above the trees and soared about, apparently hawking for insects.

The bird was seen again by W. E. Rees and myself on July 7 and 8, but not at close range.

Dr. R. W. Nero of the Manitoba Museum of Man and Nature kindly supplied the following records of Lewis' Woodpecker for Manitoba. The first Manitoba sight record was made by Mr. H. Mossop, on October 24, 1929 at Winnipeg. The first specimen was found dead on the west shore of Lake Manitoba at Sandy Bay Indian Reserve on October 28, 1935, by Rev. Father O'Chagnon, O.M.I. This is apparently the most northerly Manitoba record. Further records include six between 1929 and 1932 as well as others for '37, '38, '42 and '43.

Mr. J. L. Baillie of the Royal Ontario Museum informs me that the only Ontario sighting for Lewis' Woodpecker was at Emo, Rainy River District on May 27, 1934 by Edgar Sullivan.

Definite breeding evidence was obtained for three species of birds, which Mr. W. E. Godfrey's recently published "The Birds of Canada" lists as "probably" breeding at Churchill. A single nest was found for each of White-throated Sparrow, *Zonotrichia albicollis*, and Myrtle Warbler, *Dendroica coronata*. Both of these were in spruce-willow bush along Goose Creek Road. Also in the vicinity of Twin Lakes a Palm Warbler, *Dendroica palmarum*, was seen feeding young.

Sightings of two other species near Churchill in 1966 seem worthy of mention. Four singing male Sharp-tailed Sparrows, *Ammospiza caudacuta*, were found on July 18 and subsequently, in the extensive marshes near Akudlik. Dr. R. W. Nero states that there are few records of Sharp-tailed Sparrows for northern Manitoba.

Two Cedar Waxwings, *Bombycilla cedrorum*, were found on June 28 near the location where the Lewis' Woodpecker was seen. Cedar Waxwings have

been reported only once previously for Churchill, on June 26, 1957 by Mrs. E. Beckett (1958 *Can. Field-Nat.* 72:145-146).

These observations were made while the writer was employed as a field assistant to W. E. Rees by Dr. J. B. Falls of the Department of Zoology, University of Toronto.

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Bird Notes from James Bay in Late November

THE JAMES BAY REGION of Ontario has been actively investigated ornithologically only in the summer months. Virtually no field study has been done in that area in late autumn or winter. W. E. C. Todd (1963) made his latest visit to the region on 4 November 1912. With this in mind it may be of interest to mention some observations made by Donald H. Baldwin and myself, at Moosonee and Moose Factory, Cochrane District, Ontario, during the period 24 to 27 November 1965.

Although we were primarily interested in the House Sparrow (*Passer domesticus*) population, which totalled three individuals (Barlow, 1966), observations were made on all species and are presented here. All specimens are in the collection of the Royal Ontario Museum. The project was financed by a grant to Dr. Jon C. Barlow by the Canadian National Sportsmen's Show.

Herring Gull, *Larus argentatus*

One individual of this species was seen at Moosonee on 25 November. The Moose River was completely frozen between Moosonee and Moose Island and the gull was feeding with about thirty Common Ravens (*Corvus corax*) at the garbage dump serving Moosonee and the nearby Royal Canadian Air Force Base. The latest previous record for the region is that of a flock of ten at Attawapiskat on 10 October by Dr. George Stirrett (Manning, 1952). Attawapiskat is approximately one hundred miles north of Moosonee on the west coast of James Bay.

Evening Grosbeak, *Hesperiphona vespertina vespertina*

Two birds from a flock of fifteen were collected at Moose Factory on 26 November. The two specimens, a male (ROM 96307) and a female (ROM 96308), are both birds of the year based on incomplete skull ossification.

This record apparently represents the first occurrence of the species in the James Bay region. The previous most northerly Ontario record is that of a male (ROM 79696) taken on 13 November 1951 in Lamarche Township (northeast of the town of Cochrane), Cochrane District. Todd (1963, p. 646) mentions summering Evening Grosbeaks only as far north as Cochrane.

Swamp Sparrow, *Melospiza georgiana ericrypta*

A solitary female Swamp Sparrow (ROM 96309) was collected on 26 November at Moose Factory. The skull shows very little ossification, hence the bird may represent a late nesting. The weather in the area was seasonably cold and the ground and river were solidly frozen. However precipitation had been light and the snow cover on the ground was less than four inches so that grass and low willows remained exposed. The bird weighed 17.9 grams and the gizzard contained grass seeds and fine gravel. It was apparently in good health.

The specimen is referable to the race *ericrypta* on the basis of bright colour and back streaking.

The latest previous record for the Moose Factory area is a male (ROM 28418) taken on 9 October 1937.

Other species noted were 50 Common Ravens, 2 Gray Jays (*Perisoreus canadensis*), 15 Starlings (*Sturnus vulgaris*), a Pine Grosbeak (*Pinicola enucleator*),

and a Snow Bunting (*Plectrophenax nivalis*).

REFERENCES

BARLOW, J. C. 1966. Extralimital Occurrences of the House Sparrow in Northern Ontario. Ontario Field Biologist, 20: 1-3.

MANNING, T. H. 1952. Birds of the West James Bay and Southern Hudson Bay Coasts. National Museum of Canada Bulletin, No. 125, 108 pp.

TODD, W. E. C. 1963. Birds of the Labrador Peninsula and Adjacent Areas. University of Toronto Press, Toronto, 812 pp.

ROLPH A. DAVIS

Department of Ornithology
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Accepted April 5, 1967

A Dragonfly New to Canada

ON SEPTEMBER 9, 1964 I caught a mature male of the dragonfly, *Sympetrum ambiguum* (Rambur) (Odonata: Libellulidae), in Point Pelee Park, Ontario. To encounter this species in the extreme south of Ontario is not surprising: it has been recorded as far north as Illinois, Indiana, Ohio, Pennsylvania and Maine (Needham and Westfall *Dragonflies of North America*, Univ. of California Press, 1955). Its capture in Point Pelee Park raises the number of species of *Sympetrum* recorded in Canada to 13 and of those in Ontario to nine. The specimen is in the Canadian National Collection of Insects in Ottawa.

PHILIP S. CORBET

Entomology Research Institute
Canada Department of Agriculture
Ottawa, Ontario
Accepted April 28, 1967

Say's Phoebe, *Sayornis saya*, in Nova Scotia

ON SEPTEMBER 24, 1966, several members of the Nova Scotia Bird Society went to Seal Island, Shelburne Co., for the fourth of what promises to become an annual series of fall visits. Almost the first bird we saw on landing was identified as a robin by about half the group, and as a phoebe by the remainder. It took a couple of minutes to realize that it was neither, but a Say's Phoebe, the first for Nova Scotia. The bird was extremely active, flitting about the houses, fences, and beach boulders, and by the time our gear was unpacked, it had vanished. As this is the most easterly report of this species, it seemed desirable to obtain the specimen. It was collected later by C. R. K. Allen, and the skin was sent to the National Museum of Canada in Ottawa. It was identified as a member of the subspecies *S. saya saya*, and is the first Canadian specimen from east of Quebec.

This record is one of the most interesting examples to date of what we have come to expect of extreme southwestern Nova Scotia at this season. Almost regularly, western vagrants turn up in this area in the fall. Some have probably not come very far, for example, the Brown Thrashers that occur regularly in New Brunswick but are normally a rarity in Nova Scotia. Others, such as Dickcissels, Lark Sparrows, and Grasshopper Sparrows probably come from farther west. The Say's Phoebe undoubtedly came from a very long way. It is suggested that a possible reason for the frequency with which such wanderers appear in this region is a geographical funnelling of mis-oriented birds into a few restricted areas. It is as though the peninsula of Nova Scotia acted as a giant Heligoland Trap, with the promontories and islands at the tip serving to collect the birds.

CHRISTOPHER W. HELLEINER

Nova Scotia Bird Society
c/o Nova Scotia Museum of Science
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Accepted May 17, 1967

Observations on *Pantala flavescens* (Fabricius) (Odonata: Libellulidae) in Canada

IN A SMALL POND recently formed by blasting (1962) at the Morgan Arboretum Macdonald College, Ste. Anne de Bellevue Quebec (73° 56′W., 45°25′N.) larvae of *Pantala flavescens* (Fabricius) were first noticed on September 23, 1964. Some were in the final instar. The following spring this pond was searched carefully but no larvae were found either then or during the rest of the summer.

On August 20, 26 and 27, 1965, *P. flavescens* was seen emerging at a second pond, also excavated by blasting (in 1963). On September 2, 13 and 30, final-instar exuviae were collected showing that emergence had taken place during that month.

At a third, nearby pond (made by blasting in 1964) larvae of *P. flavescens* were collected on September 2, 4, 8 and 13, 1965. None was in the final instar. At noon on September 4 one adult female was captured while flying over the pond. In captivity, she laid 298 eggs of which 290 hatched. On October 18 larvae were found in the pond, but all were dead. These were about half grown.

These records show that this species is able to complete a generation successfully at 45°25′N. in eastern Canada. The observation that larvae die in October suggests that at this latitude summer populations of *P. flavescens* in Canada are maintained solely by migration from the south each spring.

With its capacity for rapid growth (Warren, 1915), *P. flavescens* would seem well-equipped to exploit the short growing season. A recent study of *Anax junius* (Drury) (Aeshnidae) at a neighbouring pond at the Morgan Arboretum (Trottier, 1966) indicates that its seasonal ecology is the same.

I thank Dr. P. S. Corbet for confirming the identity of the final-instar larvae, Mr. W. Hoek for telling me of the site of *P. flavescens* in 1964; and the Department of Agricultural Engineering, Macdonald College for providing the history of the ponds.

REFERENCES

TROTTIER, R. 1966. The emergence and sex ratio of *Anax junius* (Drury) (Odonata: Aeshnidae) in Canada. Canadian Entomologist 98: 794-798.

WARREN, A. 1915. A study of the food habits of Hawaiian dragonflies or Pinau with reference to their economic relation to other insects. Bulletin, College of Hawaii publications No. 3: 5-13.

ROBERT TROTTIER

Department of Zoology
University of Toronto
Accepted March 7, 1967

LETTERS

Preservation of the Byron Bog

Our Editor, writing on "The New Natural History" in Volume 81, Number 2 of this journal, makes several points concerning the impact of man as an increasingly dominant force in nature. Among these points is the important one that "we must make more serious efforts to protect samples of natural and semi-natural landscapes as well as habitats for wildlife." He requests that I give an account of the preservation of the Byron Bog as an example of the successful conservation of a sample of original territory.

The Byron Bog is a relict bog, some seventy acres in area, lying within the limits of the City of London, Ontario. Some of its features are illustrated in the Canadian Field-Naturalist, 81 (2) : 111. During the past several decades attempts have been made to exploit it commercially. Shortly before 1910 an attempt was made to drain it through a line of tiles emptying into the Thames River so that celery could be grown in it. It proved to be too deep for draining and this project was abandoned. Later, an enterprise was undertaken to skin off the upper layers of peat and to dry it for sale as fuel and packing. This too was abandoned owing to the unsuitable quality of the peat. During the depression years the farmer who owned the bog supplemented his income by selling off much of the black spruce as Christmas trees, but this enterprise petered out as Scots Pine became popular as Christmas trees. During the war of 1939-1945 the Department of National Defence removed the abundant growth of alder-buckthorn to use its wood as a component of fuse powder; but during the past twenty-five years this hardy shrub has regained its former luxuriance in the bog.

So the bog has survived in spite of attempts at exploitation and in spite of the dangers inherent in being a bit of wilderness within the limits of a city approaching a population of 200,000. In recent years, and up until being acquired as a conservation area, the bog has been the property partly of three householders who built houses on Oxford Street north of the bog and partly of a construction company which developed a subdivision on land adjacent to the westerly limits of the bog.

The process of having the Byron Bog preserved went through five stages, beginning in 1957 and culminating successfully in 1967:

1. In 1957 the Planning Board of the Township of London prepared an official plan for the township, including the Byron Bog as "open space area", thus indicating that it should be left in its natural state.

2. In 1958 one of the householders on Oxford Street requested the Township Council to take steps to have the bog preserved. It was eventually decided to approach the Government of Ontario to see what grants were available for such a programme.

3. In 1959 and 1960 the Upper Thames River Conservation Authority undertook to preserve the bog to the extent of taking options on the properties, valid to July 1, 1960. However, these options were not taken up and the scheme collapsed.

4. In 1960 attempts were made to have the bog preserved under the Wilderness Areas Act, recently passed by the Provincial Legislature. However, on January 1, 1961, that part of London Township which included the bog was annexed to the City of London and under these circumstaces it was decided that this plan was not feasible.

5. A joint committee of the Kiwanis Club of London, the Public Utilities Commission and City Council was set up and requested to take steps to have the bog preserved. From 1962 to 1967 negotiations continued and eventually grants from the Government of Ontario enabled the Upper Thames Conservation Authority to purchase the properties in the bog.

By arrangement between the Upper Thames Conservation Authority and the Public Utilities Commission the bog is now being cared for as part of London's parks sytem, with provision for its preservation in its natural state. It is proving invaluable as a study area for many groups, including natural history clubs, service clubs and students in the University of Western Ontario and in London's primary and secondary schools.

A mimeographed brochure entitled "Sources of Information on the Byron Bog" gives a list of publications concerning the biology of the bog, further references to the steps involved in preserving it, and a short description of the bog. This brochure is available on request to the writer.

August 30, 1967

W. W. Judd,
Department of Zoology,
University of Western Ontario,
London, Ontario.

NEWS AND COMMENT

Formation of the Canadian Appeal of the World Wildlife Fund

A Canadian Appeal for the World Wildlife Fund has been formed. It was inaugurated at a luncheon in Montreal in May, at which Prince Bernhardt of the Netherlands accepted the honorary presidency. Other officers of the Canadian Appeal are Senator Alan Macnaughton (Chairman), Lieutenant-General S. F. Clark (President-, and Louis Bloomfield, Q.C. (Vice-President).

The projects supported by the World Wildlife Fund include research, the acquisition and management of habitat, the provision of supplementary protection for species or areas, the re-introduction of species once native to an area but locally extirpated, and finally and most important, education. The Fund was founded in London in 1961. It is an international organization incorporated under Swiss law and has its headquarters in Switzerland.

The World Wildlife Fund is a fund-raising organization which seeks out the best possible technical advice before distributing money to support the sorts of projects noted above. Wherever possible, it extends support through existing organizations. It works closely with the International Union for the Conservation of Nature, the Fauna Preservation Society, and the International Council for Bird Preservation. One-third of the receipts from each national appeal is turned over to the international parent body and one-third is retained for projects within the country. Most of the International funds are being spent in the developing countries of Africa and Asia, which often lack the resources or skills to conserve their wildlife. Use of the remaining third of the funds raised by a national appeal is the subject of negotiation between the national appeal and international headquarters.

The Canadian Appeal of the World Wildlife Fund would welcome the support of private individuals and conservation and natural history organizations in Canada. Donations or enquiries should be directed to Senator Alan Macnaughton, 635 Dorchester Blvd., Montreal. It is expected that donations to the Fund will be exempt from income tax.

David A. Munro,
Director,
Canadian Wildlife Service.
October 11, 1967.

The Manitoba Musdum of Man and Nature

Naturalists and conservationists may be interested to know that Manitoba is going to have a new provincial museum and planetarium as part of a Centennial project. One of the more unusual and most welcome features is the provision of office space for societies related to the objectives of the museum. According to the recent annual report of the new museum – officially The Manitoba Museum of Man and Nature – the two major areas of concern will be natural history and human history, and these subjects will be combined "as a single museum of which the paramount theme is the story of man in relation to his environment." The broad spectrum of the biological sciences as well as geology and paleontology, and archeology, ethnology and history, are subjects to be covered by the museum's diversified programs.

It will be interesting to see to what extent these subjects can be interrelated in the exhibits program where the emphasis is on ecology. The main exhibition area in the museum (37,000 square feet) "will consider the natural vegetative zones in Manitoba and the relationships between living organisms within these environments. This approach will include a look at the cultures of the earliest known human beings and their descendants, and their basic relationship to this landscape." A second theme "will be concerned with the adaptation of the historic immigrant populations, emphasizing the influence of environment on immigrant culture and vice versa, through exhibits integrating natural and human history." Plans call for a series of galleries based on the Arctic and subarctic, northern forest, southern woodlands, grassland, and, perhaps most interesting of all, a gallery on the "evolving urban centre."

In a time when understanding of human ecology is becoming vitally important to ensuring maintenance of the natural landscape, it is particularly refreshing to see a new museum setting forth in this direction.

Serious students will be pleased to learn that "if communication is the primary function of the museum, research is its cornerstone" and that plans include "an adequate professional staff, and the laboratory and library facilities necessary to carry out their scientific responsibilities. Qualified officers of the museum will be expected to publish, not only for the benefit of the scientific world, but also for the enlightenment and enjoyment of the general public."

NATIONAL PARKS SCHOLARSHIPS AWARDED

THREE CANADIANS have each been awarded a $2,000 National Parks Service of Canada scholarship, the Honourable Arthur Laing, Minister of Indian Affairs and Northern Development has announced. The scholarships are tenable at Canadian Universities during 1967-68. They were awarded to people engaging in graduate training related to the planning and management of Natural Parks and Outdoor Recreation Areas.

Mr. Kamil J. Apt, 29, of 2570 Spruce Street, Vancouver, B.C., will attend the University of British Columbia to obtain his master's degree in Parks Planning and Management.

Mr. Richard P. McCutcheon, 28, from Elliot Lake, Ontario, will attend the University of Western Ontario to obtain his Ph. D. in the fields of Parks and Outdoor Recreation. Mr. McCutcheon is married. He and his wife Ann live at 44 Wood Street, London, Ontario.

Mr. Frederick M. Helleiner, 34, 317 Warren Road, Toronto, Ontario, will also attend the University of Western Ontario to obtain his Ph.D. in Geography.

When Minister Arthur Laing made the announcement that these scholarships were being offered last April, he noted that "Parks Planning and Outdoor Recreation are vocations born of modern social and economic patterns." He also underlined the fact that more than 11,000,000 people visited our parks last year, as compared with 500,000 thirty years ago. "Being so close to that trend, said Minister Laing, one of the objectives of the National Parks Service is to give vocational direction towards the natural resource base park planning and outdoor recreational management fields."

[Press Release, Department of Indian Affairs and Northern Development, Ottawa]

WINNERS OF WILDLIFE SCHOLARSHIPS ANNOUNCED

SIXTEEN YOUNG CANADIAN wildlife biologists have been awarded $1,200 Canadian Wildlife scholarships to continue their graduate studies. Topics range from a study of the biological productivity of wetlands habitat to a study of the transmission of parasites and diseases from wildlife to man and domestic animals. The purpose of the scholarship program, now in its fourth year, is to attract trained biologists into the wildlife field. Only Canadian citizens enrolled at Canadian universities are eligible.

"I am glad to report that again this year we have increased the number of scholarships" Mr. Laing said. "It is proof of the steadily growing realization by Canadians of the value of wildlife as a national resource." In 1966 ten scholarships were awarded and three the first year.

The winners were selected by a committee of senior scientists headed by Dr. D. A. Munro, Director of the Canadian Wildlife Service.

Winners are as follows:

René Jones, 30, of Harrington Harbour, Quebec, is in the second year of a Ph.D. program at the University of Western Ontario under Dr. C. D. MacInnes. He is studying the selection and use of nesting habitat by small Canada geese at McConnell River, Northwest Territories. Mr. Jones will obtain his M.Sc. from McGill University.

David N. Nettleship, 25, of Montreal, will enroll for a Ph.D. at the University of Montreal. His research, which will be supervised by Dr. P. R. Grant, will be on the common puffin at Witless Bay Islands, Newfoundland. Mr. Nettleship obtained his M.Sc. from the University of Saskatchewan with a study of the ecology of knot-turnstone relationships.

Kenneth N. Child, 22, of Matheson, Ontario, is a graduate of Carleton University, where he worked under Dr. C. A. Barlow. He plans to continue his study of ungulate ecology within boreal forests under Dr. E. Hagmeier at University of Victoria.

James A. Darley, 26, of Tillsonburg, Ontario, is completing his Ph.D. at the University of Western Ontario. He is studying the breeding behaviour of cowbirds under the supervision of D. M. Scott.

Bernard C. Lieff, 25, of Downsview, Ontario, is completing an M.Sc. program at the University of Western Ontario under the direction of Dr. C. D. MacInnes. For his Ph.D., Mr. Lieff will continue a study of the food habits of geese feeding in the McConnell River delta, Northwest Territories.

James H. Patterson, 25, of Metcalfe, Ontario, is working toward an M.Sc. at Carleton University under Dr. D. A. Smith and Dr. J. S. Tener. He is studying the biological productivity of wetlands habitat.

John B. Theberge, 26, of Guelph, Ontario, is continuing his Ph.D. program at the University of British Columbia under Dr. J. F. Bendell. He is studying population dynamics of rock ptarmigan in Alaska, Iceland, and Scotland. Mr. Theberge obtained a B.S.A. from the Ontario Agricultural College and an M.Sc. at the University of Toronto, where his research topic was howling as a means of communication among wolves.

William G. Wilson, 23, of Richmond Hill, Ontario, will enroll for a Ph.D. under Dr. J. F. Bendell at the University of British Columbia. He is presently completing an M.Sc. at York University where he studied habitat selection of birds

especially warblers, in central New Brunswick. His supervisor was Dr. C. David Fowle.

Brian R. Jacobsen, 22, of Winnipeg, Manitoba, is in the second year of a M.Sc. program at the University of Manitoba under the direction of Dr. G. Lubinsky. Mr. Jacobsen's research is on parasites of wildlife in Manitoba and their transmission to domestic animals and man.

Ralph D. Morris, 27, of Saskatoon, Saskatchewan, is working for a Ph.D. under Dr. W. J. Maher, at the University of Saskatchewan. He is studying the effects on the deer mouse of field application of sub-lethal doses of insecticide.

John P. Ryder, 26, of Saskatchewan, is completing a Ph.D. at the University of Saskatchewan under the direction of Dr. W. J. Maher and Dr. J. B. Gollop. His research concerns the breeding biology and winter ecology of the Ross' goose.

Michael Aleksiuk, 24, of Grassland, Alberta, is enrolled for a Ph.D. at the University of British Columbia, under the direction of Dr. I. McTaggart-Cowan. He is working on the adaptation of the beaver living in the Mackenzie Delta to their arctic environment.

Daryll M. Herbert, 24, of Cranbrook, British Columbia, is completing an M.Sc. degree at the University of British Columbia under the direction of Professor I. McTaggart-Cowan. He is studying the physioecology of big game, in particular, the use of range by mountain goats.

Stanley W. Speller, 24, of Victoria, British Columbia, will enter a Ph.D. program at the University of Saskatchewan. His thesis, supervised by Dr. W. J. Maher, will be on the denning behaviour of the arctic fox. He is presently completing his M.Sc. degree at Carleton University under Dr. D. A. Smith.

Frederick J. Tarasoff, 22, of Cobble Hill, British Columbia, has completed the first year of his M.Sc. program at the University of British Columbia under the direction of Dr. H. D. Fisher. He is studying the basic relationship between seals and certain related terrestrial mammals.

Bruce B. Virgon, 24, of Vancouver, British Columbia, will enroll for a Ph.D. at the University of British Columbia. He is studying the productivity of Greater Snow Geese on Bylot Island, Northwest Territories, under the direction of Dr. H. Norden.

[Press Release, Department of Indian Affairs and Northern Development, Ottawa]

GRANTS FOR NORTHERN RESEARCH AND SCIENTIFIC EXPEDITIONS

THE MINISTER OF Indian Affairs and Northern Development, Mr. Arthur Laing, announced grants totalling $245,000 to research institutions carrying out northern studies and to scientific expeditions working in the north; in addition $5,000 has been provided for a conference on northern studies.

Grants have been awarded to thirteen institutions and to three scientific expeditions. The program of grants for northern studies was begun in 1962 when a total of $60,000 was awarded to nine institutions; since that time the annual awards have grown to the present $250,000 distributed among some seventeen recipients. Awards have annually covered researches in botany, zoology, microbiology, geology, geography, glaciology, oceanography, physics, archaeology, anthropology, sociology, and economics. The northern scientific conference will help in the co-ordination of northern research and may be repeated annually.

The program, which is designed to encourage university research in the north and to assist in the training and education of northern scientists, is administered by

the Northern Co-ordination and Research Centre of the Department of Indian Affairs and Northern Development. Grants are made upon the recommendation of a special committee made up of scientists from government and university bodies who have a wide range of experience in Canada's northland. Dr. W. E. van Steenburgh, Special Scientific Advisor to the Department of Energy, Mines and Resources, has acted as Chairman to the Committee for the past three years.

Awards:

Institute or Expedition

(a) *Northern Research Institutes*

Arctic Studies Group — University of Montreal
Arctic Institute of North America — Montreal
Boreal Institute — University of Alberta
Canadian Research Centre for Anthropology — St. Paul University
Centre d'Etudes Nordiques — Laval University
Committee on Arctic & Alpine Research — University of British Columbia
President's Committee on Northern Area Studies — Lakehead University
Institute of Social & Economic Research — Memorial University of Newfoundland
McGill Committee for Northern Research — McGill University
Committee for Arctic & Sub-Arctic Research — University of Toronto
Committee on Northern Studies — University of Manitoba
Arctic Studies Conference — 1967 host, University of Saskatchewan.

b) *Northern Scientific Expeditions*

Devon Island Expedition — Arctic Institute of North America
Icefield Ranges Research Project — Arctic Institute of North America
Somerset Island Expedition — University of Ottawa.
[Press Release, Department of Indian Affairs and Northern Development]

CANADIAN BOTANICAL ASSOCIATION RESOLUTION ON NATURAL AREAS

At the second annual meeting of The Canadian Botanical Association held at Ottawa University, Ottawa, from May 31 to June 2, 1967, the following resolution was passed:

Whereas the increasing pressures of population and technolgy are rapidly reducing certain habitat types of Canada and whereas the Canadian Botanical Association views with alarm the destruction and loss of these habitats, be it resolved that selected natural areas, representativeof different types of habitats, their plant and animal communities, and whole ecosystems be preserved in biotic regions all over Canada. They are necessary for:

a) outdoor laboratories for biologists, soil scientists, microclimatologists, geomorphologists, and a great variety of other researchers;
b) maintenance of all kinds of natural conditions necessary for survival of different organisms;
c) maintenance of large, heterogeneous, natural gene pools;
d) scientific understanding of genetic adaption of different organisms;
e) research of natural vegetation, animal communities and soil;
f) development of intellectual, historical and aesthetic appreciation.

CARIBOU AIRLIFTED TO SOUTHAMPTON ISLAND IN HUDSON BAY

SOUTHAMPTON ISLAND, devoid of caribou for some 15 years, has been stocked with 51 caribou from Coats Island by the Canadian Wildlife Service.

Coats and Southampton Islands are in northern Hudson Bay and have a similar climate, landscape, and vegetation.

Southampton Island's former numerous caribou population gradually died out between 1930 and the early 1950's, probably because of overharvesting.

The Eskimos on Southampton Island are enthusiastically supporting the project and have contributed some of their Community Development Fund to help defray costs. Many Eskimos and Indians still depend on caribou for food and clothing.

Mr. T. H. Manning, a well-known arctic biologist, was in charge of capturing the caribou which were shot from a helicopter with a projectile syringe containing an immobilizing drug, and then transported to a base on Coats Island. The caribou were kept in a corral and fed lichens and some rolled oats until they could be flown by fixed-wing aircraft to Southampton Island. Caring for the caribou and releasing them were the responsibility of Mr. A. L. Look, of the Game Management Service of the Territorial Government. The request for the transfer was made by the Commissioner of the Northwest Territories.

The die-off on Southampton Islad was part of a widespread and drastic decline in caribou numbers, from about two to three million in 1900 to only about two hundred thousand in 1955. The chief causes are believed to have been overharvesting, and destruction of the forested winter range of the animals by fire.

Because of the importance of the caribou to the economy of the north, both federal and territorial governments have undertaken various conservation measures in recent years. It is hoped that re-establishment of a herd on Southampton Island will be part of a general "come-back" by these animals.

[Press Release, Department of Indian Affairs and Northern Development, Ottawa]

Proposed Amendment to the Constitution of the Ottawa Field-Naturalists' Club

I hereby give notice to the Council of the Ottawa Field-Naturalists' Club that at the next annual meeting of the Club I shall move that the Constitution be amended by the deletion of paragraph four of Article 9 and that the following revised text be substituted:

None but Active Members, Life Members, Honorary Members, Sustaining Life Members, and Benefactors shall have a vote or be eligible for any of the above elections or appointments.

(Signed) THEODORE MOSQUIN,
Chairman,
Constitutional Committee,
Ottawa, September 15, 1967.

AFFILIATED SOCIETIES

Edmonton Bird Club

President, Dr. D. Boag; *Vice-President*, J. H. Horton; *Secretary-Treasurer*, Miss J. C. Shore; *Field Secretary*, Dr. R. W. Turner; *Audubon Representative*, A. G. Porcher; *Librarian*, Dr. J. C. Holmes.

Calgary Bird Club

Address: Box 981, Calgary, Alberta. *President*, Ian R. Halladay; *Vice- President*, Jack A. Shier; *Secretary*, W. Garry McKay; *Treasurer*, John W. Price; *Directors*, Willis E. Hall and Bruce Jones.

McIlwraith Ornithological Club

President, W. G. Girling; *Past President*, W. R. Jarmain; *Vice-President*, Dr. W. H. Minshall; *Recording Secretary*, Mrs. C. E. Spruce; *Corresponding Secretary*, Miss M. Thomas, 534 Everglade Cres., London, Ont.; *Treasurer*, Miss E. M. Scott; *Migration Secretary*, P. Middleton.

Natural History Society of Manitoba

Honorary President, A. H. Short; *President*, Dr. L. B. Smith; *Treasurer*, J. Jack; *General Secretary*, Mrs. M. H. Lloyd, c/o Manitoba Museum, Civic Auditorium, Winnipeg 1, Manitoba; *Executive Secretary*, Mrs. G. Keith.

Nova Scotia Bird Society

President, Dr. Harrison F. Lewis; *Vice-Pr dent*, C. R. K. Allen; *Past President*, Dr. L Macpherson; *Secretary-Treasurer*, F. A. L. c/o Nova Scotia Museum of Science, Hali N.S.; *Editor*, Mrs. J. W. Dobson; *Member Secretary*, Miss Ethel Crathorne.

Provancher Society of Natural Histo of Canada

President, Ronald E. Blair; *First Vice-Presid* Benoit Pelletier; *Second Vice-President*, Jame Coristine; *Secretary-Treasurer*, Georges Leclerc, 628 Fraser St., Quebec, Que.

Province of Quebec Society for the Protection of Birds

President, Mr. M. D. Spencer; *Vice-Preside* Mrs. E. S. Cooper, M. H. Ouellet; *Honor Treasurer*, Miss G. E. Hibbard; *Honorary Se tary*, Miss R. S. Abbott, 164 Senneville R Senneville, P.Q.; *Librarian*, Mrs. E. Brosseau.

Toronto Field Naturalists' Club

President, Dr. P. A. Peach; *Vice-President*, J. A. Gingrich; *Secretary-Treasurer*, Mrs. Robson, 49 Craighurst Ave., Toronto 12, Onta *Assistant Secretary*, Miss Ruth Marshall; *Edi* Mr. Elmer Talvila; *Junior Club*, Mr. Rob MacLellan, 416 St. Clements Ave., Toronto Ontario.

Vancouver Natural History Society

President, Mrs. W. J. Smith; *First Vice-President*, Mr. A. W. Greenius; *Second Vice-President*, Mrs. J. M. Anderson; *Treasurer*, Mr. E. G. Barnes, Box 3021, Vancouver 3, B.C.; *Corresponding Secretary*, Mrs. H. Pinder-Moss; *Membership Chairman*, Mrs. E. Barnes; *Editor*, VNHS Bulletin, Mr. R. A. Pilkington.

The CANADIAN FIELD-NATURALIST

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THE OTTAWA FIELD-NATURALISTS' CLUB

FOUNDED IN 1879

— Patrons —

THEIR EXCELLENCIES THE GOVERNOR GENERAL AND MRS. ROLAND MICHENER

The objectives of the club are to foster an acquaintance with and a love of nature, to encourage investigation and to publish the results of original research and observations in all branches of natural history.

The club is a corporate member of the Federation of Ontario Naturalists and is affiliated with the American Association for the Advancement of Science.

The Canadian Field-Naturalist is published quarterly with the assistance of affiliated societies and of a contribution from the Canadian National Sportsmen's Show. Manuscripts representing observations or the results of original research in any branch of natural history are invited. Contributions to the Letters and to the News and Comment sections are welcome. All material intended for publication should be addressed to the editor. Opinions and views expressed in this journal are private and do not necessarily reflect those of The Ottawa Field-Naturalists' Club or of any other agency.

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THE COMING CONFERENCE ON CANADIAN PARKS

BETWEEN OCTOBER 5 and 12, 1968, the University of Calgary will host what may be the most important conference on National Parks ever held in Canada. The conference is being sponsored by the University of Calgary and by the National and Provincial Parks Association of Canada, the citizens' organization that is directly concerned with the future of Parks in this country. The conference may be supported by the Canadian Council of Resource Ministers, the National and Historic Parks Branch and certain private foundations.

Contributing to the six-day conference will be about 50 invited participants from across Canada and many parts of the world. The conference is broad in scope and approach, with members of various academic disciplines, government departments, and private organizations taking part in a topic that is of growing significance to all segments of Canadian society. It is open to the public. Since specialists from many fields will contribute to the conference and since the proceedings will be published, it is inevitable that the meeting will have an important bearing on future policies for Canadian Parks.

In the light of this conference, we should now ask – what should be the role of naturalists and their organizations in helping to determine park policy and how should this role be implemented? In considering our possible role, it seems worthwhile to examine a statement made in the House of Commons on July 23, 1960 by Mr. Alvin Hamilton, at that time the Minister of Northern Affairs and National Resources. Mr. Hamilton said: "How can a minister stand up against the pressures of commercial interests who want to use the parks for mining, forestry, for every kind of honky-tonk recreational device known to man, unless the people who love these parks are prepared to band together and support the minister by getting the facts out across the country?"

It seems clear that what is required first is firm and realistic knowledge of present-day park problems. Such knowledge will enable more of us and our organizations to channel information to the public and thereby act in support of those who wish to prevent our parks from becoming giant picnic and amusement grounds at the expense of natural beauty and wildlife. In other words, naturalists must assume a greater share of the responsibility for maintaining parks of a high quality. Certainly the future of our parks should not be left by default mainly to persons trained in outdoor recreation and town planning. The opportunities offered by the Calgary conference should be thoughtfully considered at this time. By sending representatives to the conference, natural history and conservation clubs can work toward making Canada a better place in which to live.

More information and a copy of the program can be obtained from Dr. J. G. Nelson, Department of Geography, The University of Calgary, Alberta. Dr. Nelson is convening the conference. THEODORE MOSQUIN

Mailing date of this number: 26th March, 1968

THE DISTRIBUTION AND ABUNDANCE OF ARCTIC HARES IN NEWFOUNDLAND

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One of the rarest and least known of the native Newfoundland mammals is the arctic hare (*Lepus arcticus bangsii*). The distribution maps of Cameron (1958), Hall and Kelson (1959), and Peterson (1966) indicate that arctic hares are distributed throughout the Island of Newfoundland. The purpose of this paper is to specify those sections of Newfoundland where hares are presently found and to present a hypothesis to explain the decline of hares that has occurred in the past 100 years.

The arctic hare prior to about 1860 was widely distributed throughout much of the Island of Newfoundland and even occurred in wooded sections of the island (cf. Cameron 1958, Dodds 1960). Cameron (1958) and Hall & Kelson (1959) list specimens taken on the Avalon Peninsula in southeastern Newfoundland. Cameron (1958:75) states, "Local residents on the island told the writer that as children they recall their grandparents talking of snaring "mountain hares" around the fishing village. Now these hares are so scarce that few island residents have seen one, and many are unaware of their existence."

Arctic hares are now primarily restricted to the massifs in western Newfoundland of the Southern Long Range Mountains, Northern Long Range Mountains, Buchans Plateau, Blue Hills of Couteau, Gregory Plateau, Doctors Hills, and Lewis Hills (Fig. 1). In addition I have received unconfirmed reports that a few hares still are found in the mountains north of Fortune Bay in Eastern Newfoundland (Fig. 1). I have been unable to investigate these reports.

With the possible exception of a local population north of Fortune Bay I have no evidence that arctic hares are presently found in Newfoundland east of the White Bear River. In the past 10 years the Newfoundland Wildlife Division has carried out extensive moose (*Alces alces*) and caribou (*Rangifer tarandus*) investigations in the area between the White Bear and the Grey Rivers and in the vicinity of Wolf Lake–Dolland Brook, east of the Grey River. During these investigations no arctic hares have been observed even though much of habitat lies in the subalpine or alpine life zones.

The decline and retreat of the arctic hares since about 1860 to the western massifs has been attributed to interspecific competition arising from the introduction of the snowshoe hare (*Lepus americanus struthopus* (Howley 1913, Cameron 1958, and Dodds 1960). The snowshoe hare was introduced into Newfoundland from Nova Scotia probably in the interval 1864-1876 (Dodds 1960).

The three authorities do not agree on the nature of the competition between the two hare species. Howley (1913) felt it was a behavioral interaction; he stated (p. 22): "Our splendid Arctic Hare (*Lepus Arcticus* or *borealis*), once

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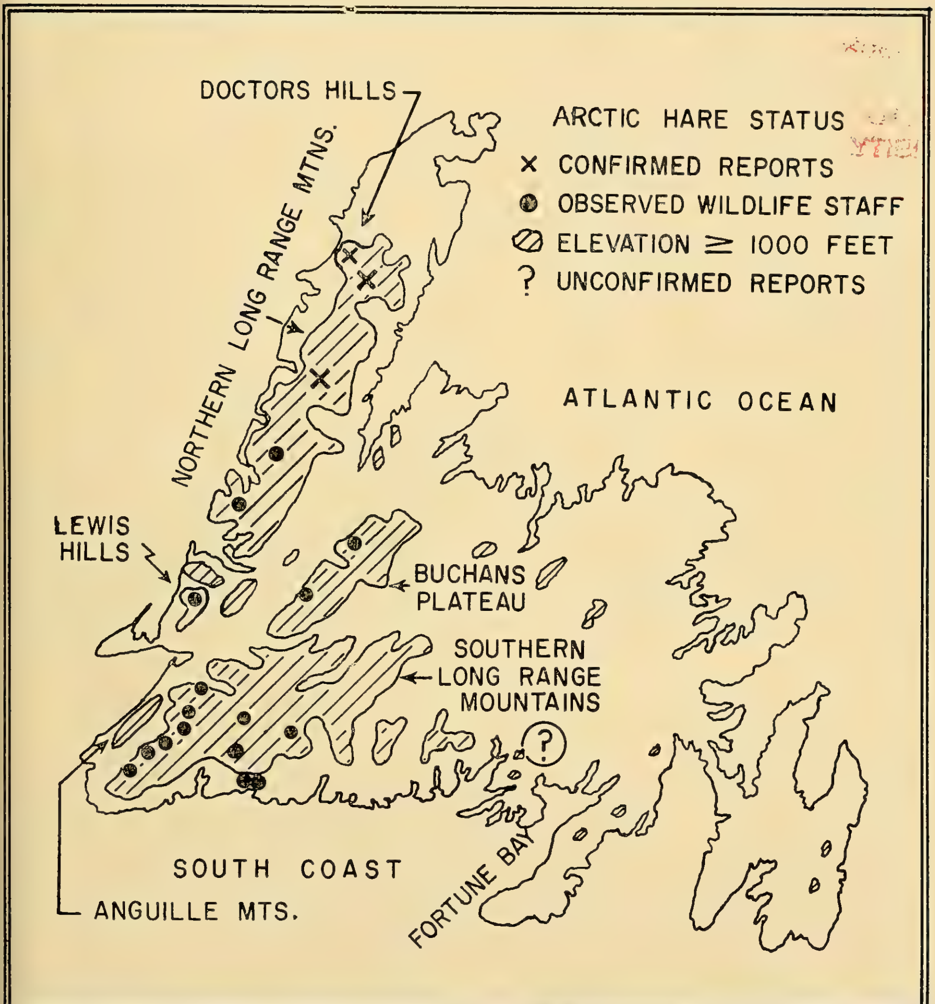

FIGURE 1. The distribution of arctic hares in Newfoundland.

fairly plentiful is now becoming quite rare. I believe the introduction here of the smaller American Varying Hare or Rabbit (*Lepus Americanus*), has done much to bring about the result. The latter is so prolific and of such a pugnacious disposition, that he has driven out the more timid native animal, and usurped his territory." On the other hand Cameron (1958) and Dodds (1960) suggested the possibility that the competition was for food. Cameron (1958:75-76) stated: "That the arctic hare reaches its most southerly extension in North America on the island of Newfoundland is interesting and may suggest that its northern distribution is the result of competition with the snowshoe hare and that in the absence of this species the arctic hare would

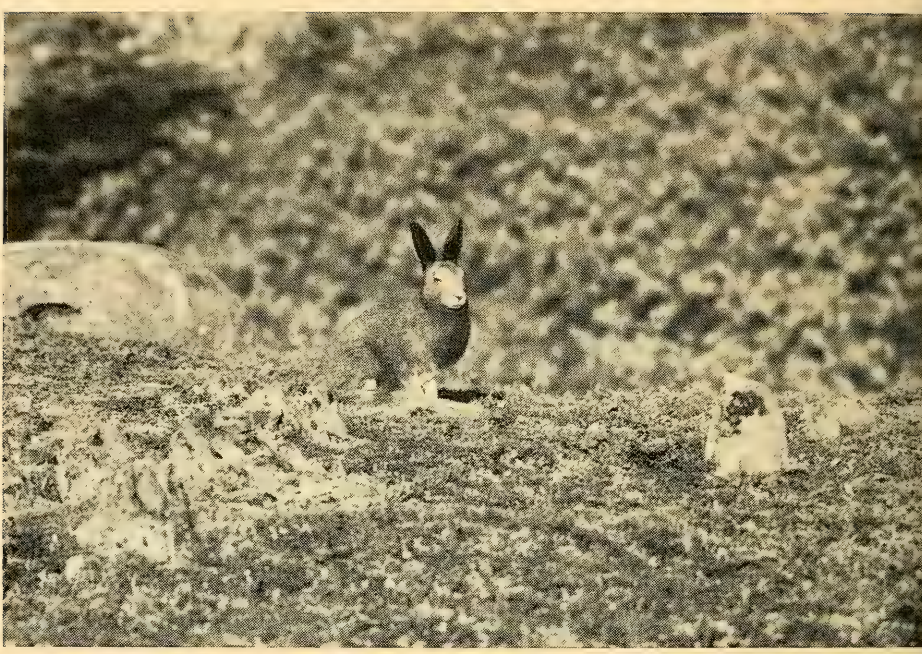

FIGURE 2. An arctic hare in the upright alert posture.
(PHOTO BY H. WILMAR)

range much farther south in Canada than is now the case . . . the exact nature of the competition is not known, though it is quite possible that food is an important factor."

It is true that each hare species at present inhabits distinct niches which might suggest interspecific competition. Arctic hares are found in some treeless habitats in the vicinity of boulder fields, while the snowshoe hare is found in all forested sections of the island that have sufficient tree growth to prevent inundation by drifting snows. The arctic hare has disappeared from wooded habitat that it once frequented and that the snowshoe now inhabits. However the arctic hare has retreated even further and no longer occupies large sections of subalpine and alpine habitats which snowshoe hares have not occupied. Failure of arctic hares to maintain themselves in these latter habitats in the absence of snowshoe hares does not support the theory of interspecific competition.

I suggest that the decline of arctic hares was not the result of direct competition with the snowshoe hare but was rather the aftermath of increased predation on arctic hares by lynx (*Lynx canadensis*) that increased in abundance following the snowshoe hare introduction.

The indigeneous status of the lynx in Newfoundland is not clear. Cameron (1958) and Saunders (1961) believed lynx probably immigrated to Newfoundland early in the post-glacial period while Dodds (1960) felt that lynx did not

appear on the Island until around 1820. The difference of opinion is due to the paucity of reports prior to the introduction of the snowshoe hare (cf. Cormack 1822, Dashwood 1871, Dugmore 1913 and Howley 1913).

It is clear however that a few lynx were present prior to the introduction of the snowshoe hare and that following the addition of a new prey species the lynx increased to extreme densities. Dodds (1960:40) indicated that the first high snowshoe hare population was present Island-wide in the interval 1896-1915. Further he felt that this "high" was the greatest density ever attained in Newfoundland. "Records of a hundred brace obtained in two nights' snaring are not uncommon" (Dodds 1960:40). The first records of the hare high were coincident with an abnormal abundance of lynx; one trapper trapped and snared 120 lynx in 1900 (Dodds 1960). "A lynx exterminating bill was brought to the (Newfoundland) Assembly on April 6, 1900. Snowshoe hare and lynx numbers remained high for several years" (Dodds 1960:40).

The prima-facie evidence that predation is limiting the distribution of arctic hares is the fact that hares are *now* found both in summer and winter primarily in the vicinity of boulder fields used as escape cover. Boulder fields within the presently occupied range that lack numerous interrock cavities are not inhabited. Also the boulder fields must be windswept at ground level to be suitable. Boulders surrounded by prostrate conifers that accumulate drifting snow are not utilized. Subalpine habitats formerly occupied but now vacant appear to lack extensive rock fields, or if present they are adjacent to forested habitat in river valleys that support snowshoe hare and lynx populations.

Recent studies of mine in Newfoundland have shown that lynx are preying heavily on caribou (*Rangifer tarandus*) calves (in preparation). Arctic hares are not found on five calving grounds where calf losses have been the greatest but are present on two other calving grounds where less lynx predation has occurred. One calving ground (La Poile River) with arctic hares and one calving ground without arctic hares (Grey River) appear similar in physiognomy. However, in the vicinity of the latter calving ground sufficient timber growth is present to support snowshoe hare populations and hence lynx. In the winter of 1965-66 33 lynx were snared on the vicinity of the Grey River calving ground.

The behavioral escape pattern of arctic hares may make them particularly vulnerable to lynx predation. Hares rely on sight to discern enemies. Foraging hares assume an upright alert posture to scan for enemies (Fig. 2). They move to a couching alarm posture upon sighting an intruder (Fig. 3). Human intruders frequently can approach to within 25 feet of a couched hare. Frequently flushed hares run a short distance and assume the alert posture before seeking escape cover in rock cavities.

A hunting lynx travels long distances at night probably relying on sight to locate prey (Saunders 1963). A stalk, last-minute-rush, and a chase are probably components of the capture sequence. Hares feeding on prostrate alpine plant growth adjacent to scattered large boulders would provide an opportunity for a high hare recognition success as well as close approach and pursuit success.

A key factor in the escape-capture equation is likely the distance of the flushed hare from the nearest rock refuge. I have noted from pellets that hares occasionally travel between rock fields over ½-mile distance. Hare populations may not be able to maintain themselves without emigration when escape cover is widely scattered.

The extinction of a local population would most likely occur during a snowshoe hare "low" (cf. Dodds 1965) at which time lynx would require an alternate food source. The problem of alternate food would be especially severe in Newfoundland which lacks a diversity of mammal species; e.g. there are only three rodent species native to the Island.

An interesting aspect of arctic hare abundance in Newfoundland is the low density of hares in the presently occupied range (see below).

Region in Newfoundland	Season & Year	Approx. Man Days in Region (Wildl. Staff)	Hares Seen
Southern Long Range Mts	Winter 1965	14	3
Lewis Hills	Summer 1963	18	3
Gregory Plateau	Winter 1958	4	Tracks of 1 or 2
Blue Hills of Couteau	Spring 1966	20	2
Connoire Bay	Spring 1966	14	3
Grandys Brook	Summer 1957	14	1
Doctors Hills	Summer 1965	1	–
Buchans Plateau	Spring 1959–63	15	2

Possibly low hare densities occur elsewhere on the mainland of Canada. Seton (1929) stated that he saw only three hares in two months in 1907. Seton's account of hares seen by others on the Canadian Mainland suggested a thinly dispersed population structure.

If a scattered, dispersed distribution is a population characteristic and not simply a question of suitable niches in the areas investigated, it could suggest that predation has been an important natural selection factor favoring dispersal behaviour tendencies rather than aggregating.

If the lynx predation hypothesis is valid then a further substantial decline of arctic hares in Newfoundland may not occur. Lynx have now been abundant for 70 years. Arctic hares have retreated to their optimum secure habitat in boulder fields.

Finally I suggest that the southern edge of the arctic hare's range in North America may depend in part on the availability of escape habitat, and the abundance of resident lynx populations dependent on snowshoe hares as a food base. Hall and Kelson's (1959) distribution maps of lynx and arctic hare show some species range overlap. However, distribution maps tend to show the entire frequented range rather than the continuously occupied range.

FIGURE 3. An arctic hare in the couched-alarm posture.
(PHOTO BY H. WILMAR)

Lynx are thought to wander widely during snowshoe hare lows. Lynx food habit studies (Saunders 1963 and van Zyll de Jong 1966) suggest to me an obligatory dependence of lynx on snowshoe hare as a staple food. Prima-facie evidence of this dependency in Newfoundland is the fact that lynx increased so phenomenally after snowshoe hares became abundant. Further refinements in our knowledge of the continuously occupied northern periphery of lynx distribution may show close agreement with the range of snowshoe hares and little overlap with the arctic hare's range. The detailed distribution maps of the three species in Ungava by Harper (1961) document this pattern. Lynx may not be able to maintain populations on the sole basis of an arctic hare diet because of low hare densities and a scattered distribution of local populations on the southern periphery of hare range.

REFERENCES

CAMERON, A. W. 1958. Mammals of the islands in the Gulf of St. Lawrence. National Museum of Canada Bulletin 154. 165 pp.

CORMACK, W. E. 1822. Narrative of a journey across the Island of Newfoundland in 1822. Edited by F. A. Bruton and republished 1928. Longmans, Green Co., London and New York. 138 pp.

DASHWOOD, R. L. 1871. Chiploquorgan, or life by the campfire. Dublin, R. W. White.

DODDS, D. G. 1960. The economics, biology and management of the Snowshoe Hare in Newfoundland. Ph.D. Thesis. Cornell Univ., Ithaca, New York. 333 pp.

———. 1965. Reproduction and productivity of Snowshoe Hares in Newfoundland. Journal of Wildlife Management 29(2):303-315.

DUGMORE, A. A. R. 1913. The romance of the Newfoundland Caribou. J. P. Lippincott Company, Philadelphia. 191 pp.
HALL, E. R. and K. R. KELSON. 1959. The mammals of North America. Ronald Press Co. New York. 2 volumes. 1083 pp.
HARPER, F. 1961. Land and fresh-water mammals of the Ungava Peninsula. University of Kansas. Museum of Natural History, Miscellaneous Publication Number 27. 178 pp.
HOWLEY, J. P. 1913. Nature studies with observations on the natural history of Newfoundland. Read before the daughters of the Empire, February 24, 1913. 32. pp.
PETERSON, R. L. 1966. The Mammals of Eastern Canada. Oxford University Press, Toronto. 465 pp.
SAUNDERS, J. K. JR. 1961. The biology of the Newfoundland Lynx (*Lynx canadensis subsolanus*). Ph.D. Thesis. Cornell Univ., Ithaca. 144 pp.
———–. 1963. Food habits of the Lynx in Newfoundland. Journal of Wildlife Management 27(3):384-390.
SETON, E. T. 1929. Lives of game animals. Doubleday Doran and Company, Volume 4. 949 pp.
VAN ZYLL DE JONG, C. G. 1966. Food habits of the Lynx in Alberta and the Mackenzie District, NWT. Canadian Field-Naturalist 80(1):18-23.

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PREDATION BY WEASELS ON A WINTER POPULATION OF LEMMINGS, BANKS ISLAND, NORTHWEST TERRITORIES

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PREDATORS are not now considered significant in causing lemming cycles although they do kill many lemmings in years when lemmings are abundant, and the populations of some predators are known to fluctuate with the lemming population. This paper reports evidence that a moderate lemming population on Banks Island, N.W.T., was almost exterminated by ermine (*Mustela erminea*) in the winter of 1962-63. The observation is considered significant in assessing the role of carnivores in the lemming cycle.

STUDY AREA

Observations were made on Banks Island in the Bernard River valley (73° 22′ N and 121° 47′ W) from 11 June to 12 August 1963.

The area is characterized by an upland of silty soil, approximately 80 feet above the river valley, which is drained by small streams and swales. Precipitation is low so that the uplands and slopes are usually dry and sparsely vegetated. Relatively luxurious vegetation develops in the bottoms of swales and stream valleys and on the edges of ponds and lakes. The upland vegetation is dominated by *Salix arctica* and *Dryas integrifolia* while the vegetation of the lowlands is dominated by *Carex stans*, *Eriophorum angustifolium* and *E. vaginatum*. Both the brown lemming (*Lemmus trimucronatus*) and the varying lemming (*Dicrostonyx groenlandicus*) are present.

OBSERVATIONS

The lemming populations were sampled by eight trap lines 1000 feet long with 153 traps in groups of three at twenty foot intervals. Six lines were in

TABLE 1. — Data on lemming specimens

Species	Date	Sex	Wt. g	Measurements mm
Dicrostonyx	June 25	M	29.8	100-8-15-3
	July 12	F	57.6	124-11-18-/
	July 21	M	30.6	111-10-16-5
	July 24	M	28.4	112-10-12-5
	July 26	M	34.7	111-9-16-/
Lemmus	July 4	M	26.5	115-11-19-10

lowland sedge habitats and two on the upland. Four lemmings, all *Dicrostonyx*, were caught in a total of 12,162 trap days between 14 June and 10 August. Spot trapping yielded two additional lemmings, an adult female *Dicrostonyx* and a subadult male *Lemmus*. Data on all specimens are in Table 1.

The presence of cuttings and winter nests indicated that there had been a moderate to low population of lemmings present on the area in the winter. Nests occurred in the places where snow would accumulate such as the lea of high banks, deep draws, the bottom of slopes and along streams. Accumulations of cut stems were noted in many streams and ponds.

Some of the winter nests showed evidence of having been predated by ermine (*Mustela erminea*), the only small mustelid on the island. The evidence was a thick lining of lemming hair in these nests, weasel droppings outside the nests, and lemming skulls, feet or stomachs in or near the nests. Records were kept of the nests encountered and evidence of predation when present. Recorded nests were destroyed to avoid duplicate records.

One hundred and fifty-three nests were found of which 30 or about 20 per cent were predated. The hair in 26 of these was examined, 25 was *Dicrostonyx* hair and one contained both *Dicrostonyx* and *Lemmus* hair.

All nests were lined with lemming hair in a manner suggesting that the weasel had used the nest, at least briefly. Some nests (three of 16 for which detailed records were kept) were apparently occupied for some time. Such nests were large, had a very heavy lining of lemming fur, and approximately a pint or more of weasel droppings outside. One also had ten lemming stomachs near it and another had nine lemming feet.

There was no evidence of weasels present in the summer.

DISCUSSION

The snap trap data suggest that the summer populations of lemmings were very low in 1963. This is confirmed by observations on the principal, avian-lemming predators in the area, the long-tailed jaeger (*Stercorarius longicaudus*), which established territories and then failed to breed.

The observations on the winter nests, however, suggests that a lemming population, consisting predominantly of *Dicrostonyx*, was destroyed by a transient population of ermine the previous winter.

A few lemmings apparently escaped predation as five of the six lemmings trapped were subadult males (Table 1), evidently born in the spring. All

were apparently new immigrants or transient individuals as they were caught after considerable trapping had been done. The adult female *Dicrostonyx* taken was also an immigrant as she suddenly began using some unoccupied burrows near camp. She was not reproductively active.

Very little is known of the history of the lemming populations on Banks Island. High populations have been described (See Manning & Macpherson 1958). The eskimos at Sachs Harbour informed me that high lemming populations occur frequently but that they do not occur simultaneously over the entire island. It seems reasonable to assume that on a local basis a three to four year lemming cycle as has been described in other parts of the arctic does occur.

Predators, may be the usual factor initiating the decline in lemming numbers in high years, although declines can occur in the absence of predation (Pitelka 1957 and 1958). Moreover, lemming populations can maintain high numbers in spite of heavy predation pressure by avian predators (Maher MS) and lemming numbers decline through the winter after the predators depart. This inability of predators to control the peaks of the lemming cycle has caused recent investigators to devote little attention to their possible role in causing the cycle. Pearson (1966) has recently focused attention on the mammalian predators and suggested that they may influence the cycle by reducing a microtine population, already declining, to such a low level that recovery is retarded for two or three years; thus causing the periodicity and amplitude of fluctuation characteristic of the microtine cycles.

According to this view mammalian predators would disperse as hunting became locally unprofitable, and since their populations had built up to a high level, the roving animals would efficiently "mop-up" most of the surviving rodents. Eventually most predators would starve and allow the prey population to increase again.

The observations presented here seems to support Pearson's suggestion.

Acknowledgements

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References

KREBS, CHARLES J. 1964. The lemming cycle at Baker Lake, Northwest Territories, during 1959-62. Arctic Institute of North America Technical Paper Number 15. 104 pp.

MANNING, T. H. and A. H. MACPHERSON. 1958. The mammals of Banks Island. Arctic Institute of North America Technical Paper Number 2. 74 pp.

PEARSON, OLIVER P. 1966. The prey of carnivores during one cycle of mouse abundance. Journal of Animal Ecology 35: 217-233.

PITELKA, FRANK A. 1957. Some characteristics of Microtine cycles in the Arctic. Oregon State College, 18th Biology Colloquim, pp. 73-88.

———. 1958. Some aspects of population structure in the short-term cycle of the brown lemming in northern Alaska. Cold Spring Harbor Symposium on Quantitative Biology, Volume 22:237-251.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. V. *B. PAPYRIFERA* AND *B. CORDIFOLIA* FROM EASTERN CANADA

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Four birch species with white or whitish bark occur in eastern Canada. They include, (1) the canoe, paper or white birch, *B. papyrifera* Marsh., (2) the mountain white birch, *B. cordifolia* Regel, (3) the gray or wire birch, *B. populifolia* Marsh. and (4) the blue leaf birch, *B. caerulea-grandis* Blanchard. Of these, only *B. papyrifera* is of transcontinental range, lining the margins of highways, lakes and streams from coast to coast, flourishing alike on barren hillsides, damp uplands and in chance breaks in the forest cover and spreading northward, even to points beyond the Arctic Circle. The present paper deals with the first two species only and excludes New Brunswick and Nova Scotia material previously reported (Brittain and Grant, 1965a, b).

Although it is too early to judge the validity of all the varieties proposed for *B. papyrifera*, our preliminary study of this species over its transcontinental range discloses such a series of overlapping characteristics as to render at least some of the varieties of very doubtful significance. This applies to *B. papyrifera* var. *elobata* (Fern.) Sarg. based on a single immature specimen from Gaspé Co., Quebec, *B. papyrifera* var. *commutata* (Regel) Fern. applied to any individual having dark brown bark, and *B. papyrifera* var. *subcordata* (Rydb.) Sarg. based on characters falling well within the range of variation of the species. Dugle (1966) has stated that var. *commutata* is not distinct and not worthy of recognition. However, it seems that *B. papyrifera* var. *cordifolia* (Regel) Fern. should be given specific rank (*B. cordifolia* Regel, Brittain and Grant, 1965b). In addition, two so-called varieties of *B. papyrifera*, var. *humilus* (Regel) Fern. and Raup, and var. *neoalaskana* (Sarg.) Raup, are synonymous with *B. resinifera* Britt. and should be relegated to this taxon. The latter treatment has been considered as the correct one for these varieties by Dugle (1966).

Our morphological and cytological techniques employed have been previously described (Brittain and Grant, 1965a). The majority of the specimens were collected by the senior author during the years 1960 to 1964.

Observations and Discussion

Table 1 summarizes the more outstanding characters from the technical description prepared for each specimen. The fruiting and folial characters are illustrated in the drawings (Figures 1-4) for the different accessions.

Considerable morphological variability exists between individual *B. papyrifera* specimens as might be expected in a species of such wide range and occupying so many diverse sites. This is particularly noticeable in the basal

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area of the leaf which may be cuneate, rounded, truncate or subcordate. In fruiting characters, the form of the bract is conspicuously variable. For example, the lateral lobes may be porrect (Figure 1, 290b), extend horizontally (Figure 3, 280b), or be sharply recurved (Figure 1, 284b).

From a study of our specimens we have no clear evidence for creating geographical races of *B. papyrifera* in eastern Canada. However, regional morphological variations were noted. In Newfoundland, variability between specimens was marked. This might be accounted for as a result of the wide range of ecological situations where *B. papyrifera* is found and also its close intermixture with *B. cordifolia* which allows for hybridization between these two species (Table 1).

Small but consistent differences were noted in the Prince Edward Island specimens many of which had proportionally longer and narrower leaves than the average for the species. The guard cell measurements were smaller and the seeds and twigs were glandular, especially in the young seedlings, which also exhibited a lesser degree of pubescence. The associated birch trees were *B. populifolia* and *B. caerulea-grandis.* These two species, which are not present in Newfoundland, are both found in eastern Quebec and in the northern areas with *B. cordifolia.*

The least variation noted was in specimens from western Quebec and eastern Ontario where *B. caerulea-grandis* and *B. cordifolia* are both absent, though *B. populifolia* is present and often abundant.

As we proceed west and north through Ontario, *B. populifolia* gradually fades out and *B. cordifolia* again appears. However, *B. cordifolia* apparently does not enter the prairie region and our own furthest west collection was at Savanah, Ontario.

It is clear that *B. cordifolia* occupies only the cooler portions of the range of *B. papyrifera,* and in these areas, the two are commonly associated in clumps or thickets. Its common name "mountain white birch" is misleading since it would seem to imply that the species is only found on elevated sites, whereas, it is very common in the cooler coastal regions. In fact, in our own collections it was relatively most common on the Island of Grand Manan, New Brunswick.

A detailed comparison of *B. cordifolia* and *B. papyrifera* has already been given (Brittain and Grant, 1967) and it is only necessary at this point to emphasize that, in contrast to the high rate of variability in *B. papyrifera, B. cordifolia* presents us with a series of relatively stable characters. Curiously enough, it is in what has been considered the most characteristic feature of the species, namely, the cordate leaves, that we find the greatest degree of variation. Indeed, the late G. C. Cunningham believed there was a "maritime form" of *B. cordifolia,* common along the shore of the Bay of Fundy and along the Gulf of St. Lawrence, characterized by a greater than average proportion of leaves with rounded, or truncate, rather than cordate bases, though all other characters were of this species. Such specimens have been observed in our collections from various maritime sites. For example, in our Grand Manan collections these individuals appear more frequently than those possessing the typical leaf shape.

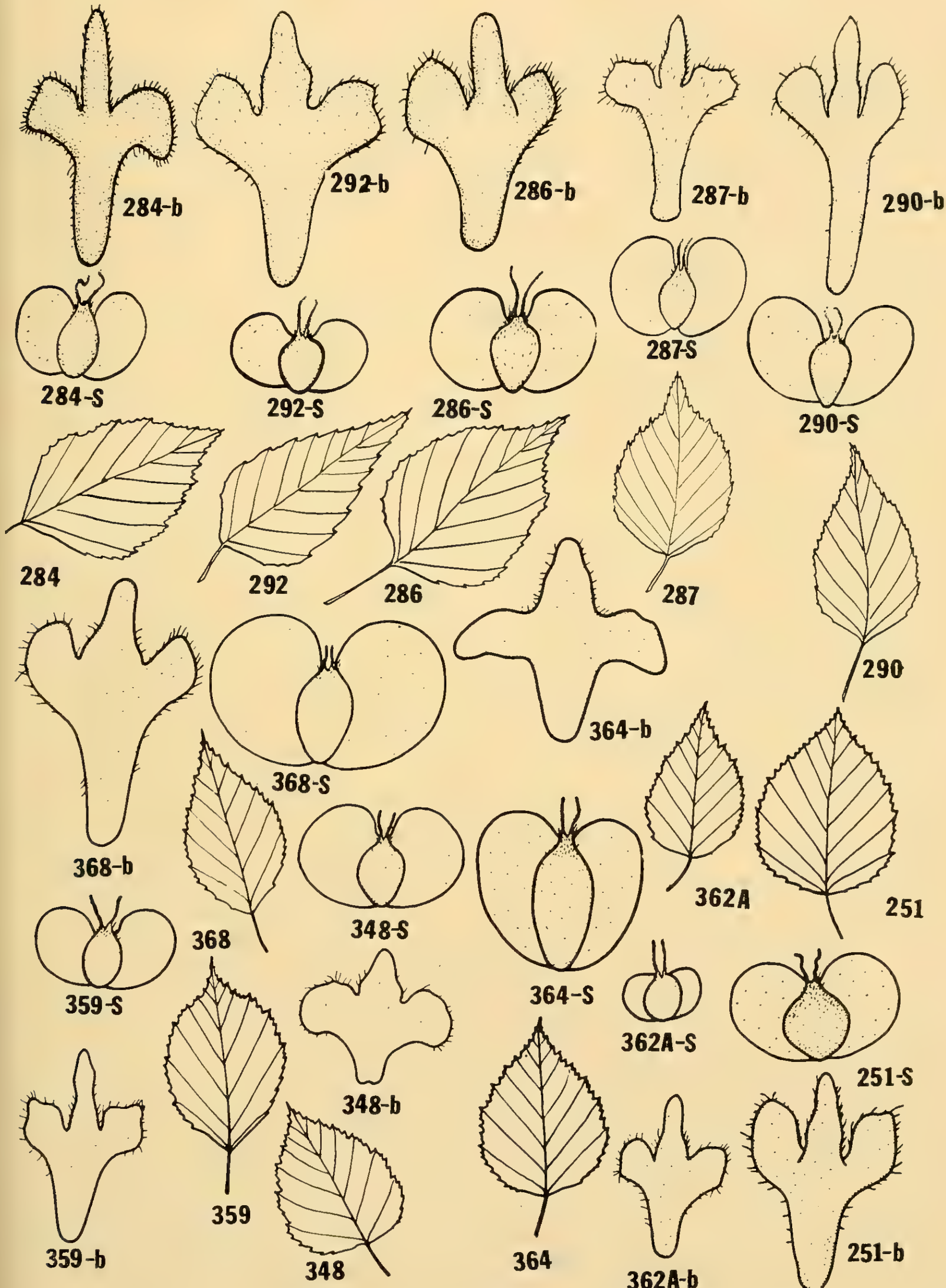

FIGURE 1. Representative illustrations of bracts and samaras (× ca. 6) and leaves (reduced ca. ⅔) of *B. papyrifera*. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara.

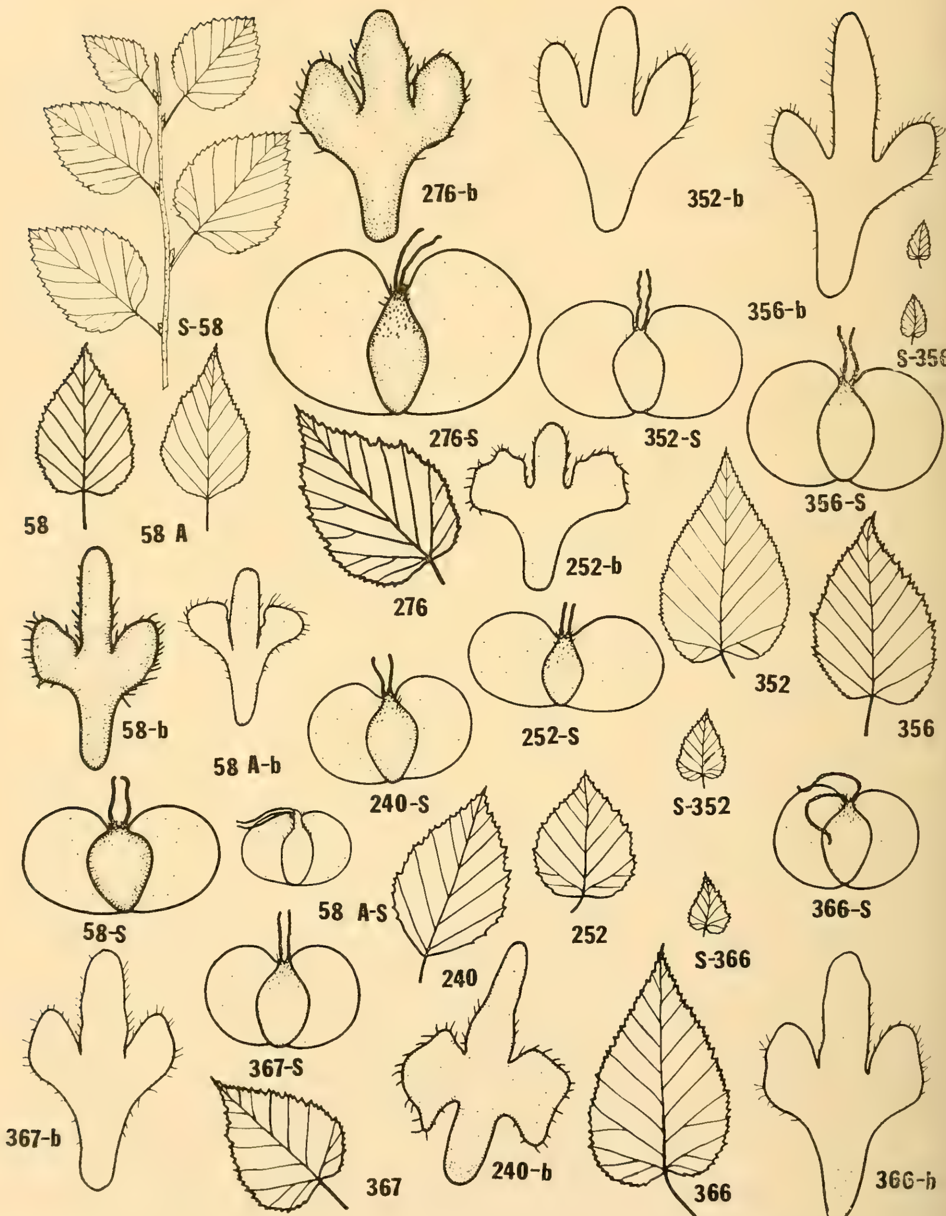

FIGURE 2. Representative illustrations of bracts and samaras ($\times$ ca. 6) and leaves (reduced ca. $\frac{3}{5}$) of *B. cordifolia* with the exception of numbers 240, 252 and 276 which are considered to be hybrids between *B. cordifolia* and *B. papyrifera*. S-58, seedling stem. S-356, two seedling leaves showing size variation; S-352, S-366, seedling leaves. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara.

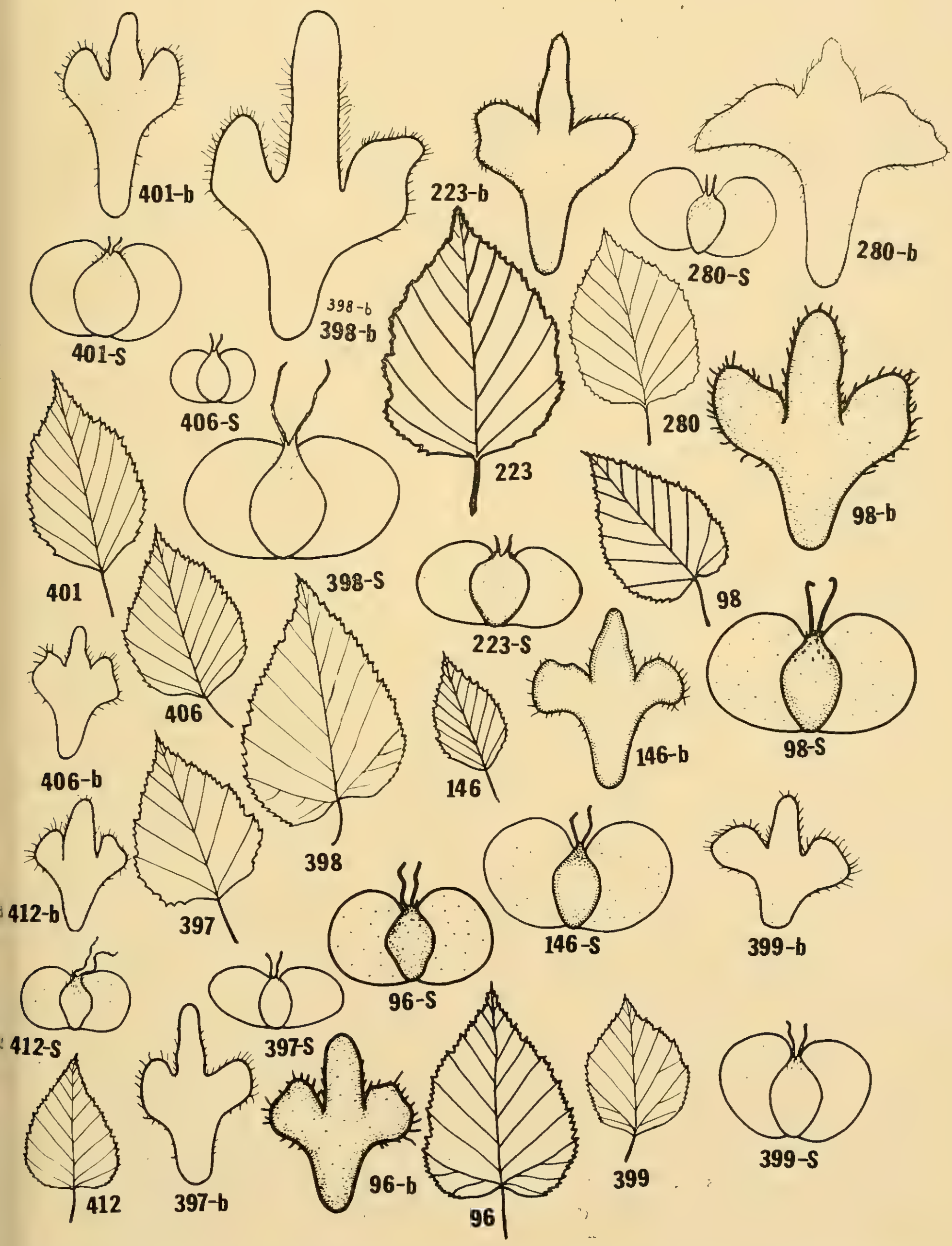

FIGURE 3. Representative illustrations of bracts and samaras (× ca. 6) and leaves (reduced ca. $\frac{3}{5}$) of *B. papyrifera,* except 96, 98 and 398 *B. cordifolia.* The numbers refer to accession numbers as given in Table 1. b = bract; S = samara.

As may be noted in the illustrations, the form of the fertile bract of *B. cordifolia* [Figures 2, 3 (96b, 98b, 399b), 4 (180b)] is quite consistent, whereas it is most variable in *B. papyrifera*. In *B. cordifolia* there is usually a long median lobe with parallel sides, and porrect lateral lobes with smoothly curving outer margins. Furthermore, the sparsely hispidulous achene is provided with exceptionally long styles, sometimes even exceeding the achene itself in length. The average length of the style in our specimens was 4 mm in contrast to 3 mm for *B. papyrifera*. Seed catkins of *B. cordifolia* are on the average larger and plumper than those of *B. papyrifera*.

While in some cases the number of serrations per side of the leaf overlapped between specimens of *B. papyrifera* and *B. cordifolia*, the average numbers of 30.2 for the former species and 40.6 for the latter are significantly different. Likewise in a few cases, measurements of the length of the stomatal guard cells overlapped between species, but again on the average the measurements are significantly different, being 32.48 μ for *B. cordifolia* and 39.74 μ for *B. papyrifera*. Considerable variation existed between the stomatal guard cell measurements for the different hybrids (average 37.17 μ). Both number of leaf serrations and stomatal guard cell measurements are not considered reliable for specifically designating single individual hybrids.

The seedlings of *B. cordifolia* are readily distinguishable from those of *B. papyrifera*. In the latter species the stem is densely pubescent, whereas in *B. cordifolia* the stem is relatively glabrous or, at least, much more sparsely pubescent. In *B. cordifolia* patches of cuticle adhere to the stem, especially around the stomata imparting a more or less characteristic mottled appearance.

The growth rate of young *B. papyrifera* seedlings is decidedly more rapid than in *B. cordifolia*. In our nursery, where conditions favour an optimum growth, the linear growth after three years was 101.60 cm for *B. papyrifera* and 60.96 cm for *B. cordifolia*. Over a period of five years the gap widened still further and the average for 50 specimens of each species was 3.18 and 1.02 meters, respectively. In addition to the foregoing, the smaller, darker, narrower leaves of the young seedlings of *B. cordifolia* make it possible to readily distinguish between these two species even in the seed bed.

We do not know how long growth continues at the rate indicated, or what the comparative growth rates would be under the natural habitats of the species, though our observations give some evidence that a certain differential does exist. In any case, the results indicate inherent differences in growth rate between these two species.

Finally, the somatic chromosome number of 28 is characteristic of *B. cordifolia*, though a few specimens typical in all respects for the species had a chromosome number of $2n = 56$. The latter number was also determined for some specimens which were clearly hybrids and which were found at locations in which the two species were intimately associated. Such sites were present near St. Phillips and Notre Dame Junction in Newfoundland and at Wawa and Agawa Rivers in northwestern Ontario (Table 1).

Comments on several collections are worth noting. Among the atypical specimens is number 275 from St. Phillips, Newfoundland, which has sharply cuneate leaves. A specimen with similar characteristics (No. 58A) was col-

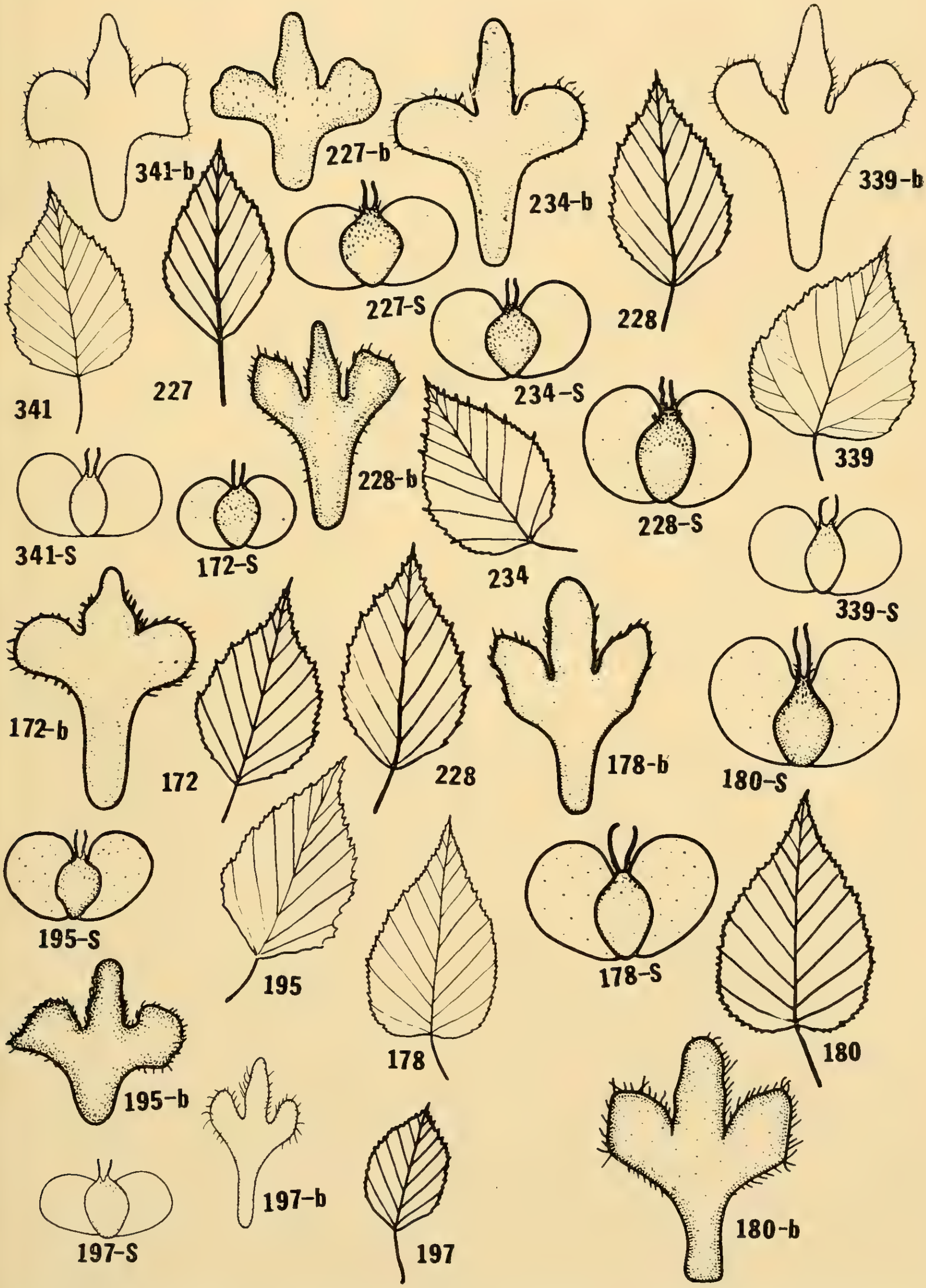

FIGURE 4. Representative illustrations of bracts and samaras (× ca. 6) and leaves (reduced ca. ⅔) of *B. papyrifera*, except 180 *B. cordifolia* and 178 and 197 hybrids between *B. cordifolia* and *B. papyrifera*. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara.

TABLE 1.—Summary of observations on some Birch collections from Eastern Canada[1]

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)	Remarks
58	Schefferville, Quebec	28	30.28	*B. cordifolia.*
58A	Schefferville, P.Q.			*B. cordifolia.* Growing near preceding; fruit as in *cordifolia*, but many leaves cuneate or truncate.
84	Morgan Arboretum, P.Q.	84	41.44	
85	Havre St. Pierre, P.Q.	28	27.66	*B. cordifolia. B. pumila* and *B. glandulosa* present.
96	Romaine Island on Romaine River, P.Q.	28	28.69	*B. cordifolia*; no *B. papyrifera* noted near this site.
97	Anticosti Island, P.Q.		34.12	Similar to Fernald's *B. papyrifera* var. *macrostachya.*
98	Anticosti Island, P.Q.	28	30.47	*B. cordifolia.*
146	Arvida, P.Q.	70	31.65	
147	St. Jean Port Joli, P.Q.	70	46.50	
148	Arvida, P.Q.	70:84[4]	40.03	
223	La Malbaie, P.Q.		42.94	
236	Morgan Arboretum, P.Q.	84		
280	Hudson, P.Q.	70	38.16	
394	Valcartier, P.Q.	28	39.10	*B. cordifolia.*
395	Amqui Road, P.Q.	84	41.81	Leaves shallow cuneate; bracts with lateral lobes ascending.
396	Amqui Road, P.Q.	84	50.62	
397	Amqui Road, P.Q.	84	38.72	
398	Matane Airport, P.Q.	28	30.62	*B. cordifolia.*
399	Murdochville, P.Q.	84	40.03	
400	Gaspesia Park, P.Q.	84	38.06	
401	Gaspesia Park, P.Q.	84	39.00	
402	Near Mt. Albert Lodge, P.Q.	84	38.25	
403	Near Mt. Albert Lodge, P.Q.	84	38.91	
404	Gaspesia Park, P.Q.		30.56	*B. cordifolia.*
405	Nouvelle Ouest, P.Q.	84	48.19	
406	Millstream, Metapedia River, P.Q.	84	37.97	
407	West River Gate, Gaspesia Pulp and Paper Co., P.Q.	84	45.75	
412	Baie Comeau, P.Q.		37.50	
415	Forestville, P.Q.			
240	Port aux Basque, Nfld.	56[3]	38.62	Fruit, foliage and seedling characters resemble *B. papyrifera* but bract with exceptionally long median lobe; possible hybrid.
251	Corner Brook, Nfld.	84[3]	44.06	
252	Gull Pond, Nfld.	56	44.63	Hybrid. Leaf and growth characteristics intermediate to *cordifolia* and *papyrifera.*
253	North Branch, Nfld.	56[3]	38 63	Possible hybrid.
274	St. Phillips, Nfld.	28	32.40	*B. cordifolia.*

TABLE 1.—cont'd.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)	Remarks
275	St. Phillips, Nfld.	28[2]	45.20	*B. cordifolia.*
276	St. Phillips, Nfld.	56[3]	36.50	Hybrid. Parental characters as in *cordifolia;* seedling characters as in *papyrifera.*
277	Notre Dame Jct., Nfld.	28:56[3]	33.80	*B. cordifolia.*
278	Notre Dame Jct., Nfld.	84[2]	30.10	Some leaves rounded or truncate at base; seedlings resemble *cordifolia.*
279	Notre Dame Jct., Nfld.	84[2]		Fruit approaches that of *cordifolia,* otherwise as in *papyrifera.*
348	St. Phillips, Nfld.	84	39.94	Large plump seed; short stigmas.
349	St. Phillips, Nfld.	84	38.72	
350	St. Phillips, Nfld.	28	35.62	*B. cordifolia.*
351	St. Thomas, Nfld.	84[3]	33.84	
352	Ocean Pond, Nfld.	28[2]	28.69	*B. cordifolia.*
353	Near Mt. Pearl, Nfld.	84	41.62	
354	Gander, Nfld.	56[3]	34.60	*B. cordifolia.*
355	Gander, Nfld.	84	46.40	
356	Gander Bay Road, Nfld.	28	32.25	*B. cordifolia.*
357	Gander Bay Road, Nfld.	84	41.06	Leaves sharply cuneate; achene small, bracts ascending.
358	Gander Bay Road, Nfld.	84	42.19	
359	Notre Dame Jct., Nfld.	84	37.27	
360	Notre Dame Jct., Nfld.	84	37.50	
361	Notre Dame Jct., Nfld.	70	38.25	
362	Lewisport Road, Nfld.	84	37.69	
362A	Lewisport Road, Nfld.	84		Contains an element of *B. glandulifera.*
363	Goose Bay, Labrador		36.66	Female ament short and plump; seed relatively large; ascending lobes.
364	Goose Bay, Labrador	84[2]	41.62	Resembles No. 363 except for diverging bracts.
365	Northwest River Road, Labrador.	28	34.78	*B. cordifolia.*
366	Northwest River Road, Labrador.	28	30.66	*B. cordifolia.*
367	Northwest River Road, Labrador	28	32.44	*B. cordifolia.*
368	Mud Lake, Labrador	84		Achene with short stigmas only 1/3 its length.
369	Hamilton River, Labrador	84	40.22	Very long narrow achene, 2.75 mm × 2.5 mm.
413	Marble Island, Labrador		31.78	*B. cordifolia.* Leaves sharply cuneate.
284	Tracadie, P.E.I.	84[2]	40.31	Median lobe of bract very long, up to ½ total length. Twigs glandular, especially in seedlings.

TABLE 1.—cont'd.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)	Remarks
286	Newton Cross, P.E.I.	56:70[4]	38.44	Very long narrow leaves; small seeded. Glandular as in No. 284.
287	Stanhope, P.E.I.	70:84[6]	39.75	Glandular as in No. 284.
288	Stanhope, P.E.I.	84		Glandular as in No. 284.
289	Hunter River, P.E.I.	84	38.81	Similar to No. 286; achene 2.35–2.5 mm long. Glandular as in No. 284.
290	Charlottetown, P.E.I.	84	34.41	Glandular as in No. 284.
291	Northam, P.E.I.	70		Glandular as in No. 284.
292	O'Leary, P.E.I.	84	34.59	Very long narrow leaves; small seeded. Glandular as in No. 284.
341	Prescott, Ontario		41.16	
226	Lowell Lake, Timogami, Ont.		35.81	
227	Manitoulin Island, Ont.	70[2]	40.13	
228	Tobermory, Ont.	84[3]	41.34	Limbs pendulous; leaves long and narrow; achene narrow, half as wide as long.
229	Oliphant, Ont.		34.03	
230	Oliphant, Ont.	84[3]	44.16	
231	Chalk River, Ont.		41.06	
232	Chalk River, Ont.	70	42.38	
233	Chalk River, Ont.	56:84[4]	40.31	
234	Chalk River, Ont.	70		
235	Chalk River, Ont.		40.31	
237	Chalk River, Ont.	84		
339	Port Hope, Ont.		41.81	
340	Bancroft, Ont.		41.15	Long narrow leaf and achene.
170	Echo Bay, Ont.	70	39.09	
171	Thessalon, Ont.	70[2]	38.06	
172	Kirkwood, Ont.	70:84[4]	42.94	
175	Big Basswood Lake, Ont.	70	38.34	
176	Batchawanna Lake, Ont.	70	41.06	
178	Agawa River, Ont.	42:56[4]	27.20	Hybrid. Leaf variable, fruit resembles *B. cordifolia*.
179	Wawa, Ont.	56:84[4]	35.60	Hybrid. Leaf variable; fruit resembles *B. cordifolia*.
180	Catfish Lake, Ont.	28:42[7]	29.00	*B. cordifolia*.
181	Croker Lake, Ont.	70	48.84	
182	Marathon, Ont.	70	39.47	
183	Billie Lake, Ont.	70[3]	37.31	
184	Nipigon, Ont.	84	39.56	Bract with median lobe equalling ½ its length.
185	Sibley, Ont.	56	40.59	
186	Sibley, Ont.	28	31.12	*B. cordifolia*.
187	Port Arthur, Ont.	70	39.19	Very broad achene.
188	Kakabeka Falls, Ont.	70	34.97	
189	Savannah, Ont.	84	40.41	
190	English River, Ont.	84	47.81	Leaf with long acuminate tip.
191	Vermillion Bay, Ont.		41.81	

TABLE 1.—cont'd.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)	Remarks
192	Upper Falls, Red Lake Highway, Ont.	70	42.19	
193	Red Lake Highway, Ont.	70[2]	39.93	
194	Cedar Lake, Ont.			Leaves long, acuminate.
195	Laclu Road, Ont.		41.16	
196	Fort Beausejour, Manitoba	70:84[4]	39.09	
197	Riding Mt. Park, Manitoba	56	40.50	Hybrid. Single stem, on dry site, but with characters suggestive of *B. fontinalis*.
198	Riding Mt. Park, Manitoba.		39.38	
199	Riding Mt. Park, Manitoba.	84[2]	37.22	

[1]Specimens are *Betula papyrifera* unless otherwise noted.
[2]Determination from two seedlings.
[3]Determination from three seedlings.
[4]Two seedlings with different chromosome numbers.
[5]Three seedlings examined; two with 28 chromosomes.
[6]Three seedlings examined; two with 70 chromosomes.
[7]Five seedlings examined; four with 28 chromosomes.

lected near Schefferville, Quebec, in an area where *B. glandulosa* was abundant and *B. pumila* was also present. Seed germination was unusually low in the case of the St. Phillips collection (No. 275) in contrast to that for typical seed of *B. cordifolia* and only a single seedling was obtained. The chromosome number of this seedling, however, was $2n = 28$ which is characteristic for *B. cordifolia*. Also from St. Phillips was number 276, in which the parental characters were typical *B. cordifolia*, but the seedlings had 56 somatic chromosomes and characters of *B. papyrifera* indicating that the seedlings were in all likelihood hybrids between these two species.

Our number 278 from Notre Dame Junction, Newfoundland, appears to be a hybrid between *B. cordifolia* and *B. papyrifera*. The fruit is typical of *B. cordifolia*, whereas the foliage more closely resembles that of *B. papyrifera*. The seedling characters were closest to *B. cordifolia*. However, chromosome numbers for two seedlings were $2n = 84$.

Specimens of number 362A have certain characters of *B. pumila*, suggesting the tree originated from a cross between *B. papyrifera* and *B. pumila*. In contrast to the more shrubby nature and the boggy ground characteristic for stands of *B. pumila*, this tree had a single stem, approximately 6.0 meters in height and was growing on a rather damp, but by no means boggy site. The single seedling for which a chromosome number was determined was $2n = 84$ in contrast to $2n = 56$ which has been reported for *B. pumila* (Clausen, 1962).

Specimens of number 58 came from a tree growing in a burnt over region. near Schefferville, Quebec, an area in which *B. glandulosa* and *B. pumila* were also present. The tree was typically *B. cordifolia*, but its seedlings are of the

multistemed dwarfish type and in general appearance resemble most closely those of *B. pumila.* A chromosome number of $2n = 28$ was determined for one of these seedlings.

Studies are underway to elucidate some of the complexities which have been noted including controlled hybridization, chromatographic analyses, as well as the determination of the chromosome number for additional seedlings.

SUMMARY

A morphological and cytological study has been carried out on a collection of *Betula papyrifera* Marsh. and *B. cordifolia* Regel from eastern Canada. Considerable morphological variability exists between different collections of *B. papyrifera,* which in part reflects the wide range and diverse ecological sites occupied by this species. Geographical variants were noted but these were not sufficiently distinct from the general population to warrant taxonomic delineation. *Betula cordifolia* was not as variable as *B. papyrifera* and could be distinguished from the latter by the average of the stomatal guard cells, numbers of serrations per side of leaf and the seedling characters of pubescence and growth rate. The somatic chromosome numbers of *B. papyrifera* were determined as 84 or 70, but a few specimens had 56 and could not be distinguished morphologically from those with a chromosome number of 70 or 84. The chromosome number of *B. cordifolia* was $2n = 28$ but a few tetraploid collections ($2n = 56$) were found. A number of hybrids were detected between *B. cordifolia* and *B. papyrifera* ($2n = 56$) and other hybrid combinations and atypical specimens were noted.

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REFERENCES

BRITTAIN, W. H. and GRANT, W. F. 1965a. Observations on Canadian birch (*Betula*) collections at the Morgan Arboretum. I. *B. papyrifera* in eastern Canada. Canadian Field-Naturalist 79: 189-197.

———. 1965b. Observations on Canadian birch (*Betula*) collections at the Morgan Arboretum. II. *B. papyrifera* var. *cordifolia*. Canadian Field-Naturalist 79: 253-257.

———. 1967. Observations on Canadian birch (*Betula*) collections at the Morgan Arboretum. IV. *B. caerulea-grandis* and hybrids. Canadian Field-Naturalist 81: 116-127.

CLAUSEN, K. E. 1962. Introgressive hybridization between two Minnesota birches. Silvae Genetica 11: 142-150.

DUGLE, J. R. 1966. A taxonomic study of western Canadian species in the genus *Betula*. Canadian Journal of Botany 44: 929-1007.

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WEIGHTS AND MEASUREMENTS OF MOOSE IN ELK ISLAND NATIONAL PARK, ALBERTA

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IN HIS BOOK on the North American moose (*Alces alces*), Peterson (1955) remarked that "because of the great difficulty of getting moose and scales together, relatively few accurate weights are available". To alleviate this paucity of data, whole weights of 35 moose (*A. a. andersoni*) were obtained during moose herd reduction programs at Elk Island National Park, Alberta, in 1960 and 1963. In addition, weights of fully dressed carcasses of 261 moose killed in 1959, 1960 and 1963 are available. The weights and measurements are presented in the hope that they will provide a useful base for comparison with other herds which are subjected to different conditions of habitat or population density, and for comparing with captive animals fed experimental diets. They may also be useful to taxonomists in establishing more significant differences between the races of moose, and to range ecologists who wish to equate various ungulates in terms of animal units.

Elk Island National Park is located in a hilly upland of east-central Alberta about 30 miles east of Edmonton, at an elevation of about 2,400 feet. Soils are primarily orthic grey-wooded and are relatively low in natural fertility (Holsworth 1960). The vegetation is primarily aspen parkland with an intrusion of boreal elements. A series of forest fires previous to 1940 has altered the original climax white spruce cover to a seral stage dominated by aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*). The park consists of adjacent 50 and 25 square mile areas, each fenced around the perimeter. The fence prevented ingress or egress of moose. Both areas contained bison (*Bison bison*), elk (*Cervus canadensis*), white-tailed deer (*Odocoileus virginianus*), and mule deer (*O. hemionus*), as well as moose, during the period the moose data were obtained. As a result of a series of extensive herd reductions in the 1950's, ungulate numbers in the park in the 1959-1963 period, with the possible exception of bison, were within the carrying capacity of the range. Park ranges at that time were considered to be in good condition. Moose densities just preceding the herd reductions of 1959, 1960 and 1963, based on aerial inventory, were 3.9, 2.6 and 5.1 per square mile respectively (Blood, 1966). Rates of population increase of Elk Island moose during the intervals between herd reductions suggest that the weights and measurements discussed herein were obtained during positive acceleration and/or logarithmic growth phases.

METHODS

Moose were hunted and shot in the field by Park Wardens, then transported by truck to the park abattoir. Whole weights were obtained to the nearest pound at the kill sites with a 1600 pound capacity beam scale suspended by a

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TABLE 1. — Body measurements in inches of 35 moose

Age Class	Sex	Sample Size*	Parameter	Hind Foot	Chest Girth	Total Length	Shoulder Height	Ear Length
Calf	M	5 (3)	Mean	28.2	56.9	78.0	62.8	9.3
			Range	27.5 – 28.6	55.5 – 58.0	75.5 – 79.5	62.0 – 64.0	9.0 – 9.5
Calf	F	4 (4)	Mean	27.0	56.3	75.6	58.8	8.8
			Range	25.9 – 27.8	54.3 – 59.0	73.0 – 79.0	57.0 – 61.0	8.8 – 8.9
Yearling	M	2 (2)	Mean	30.8	67.0	91.3	70.5	10.4
			Range	30.3 – 31.3	66.0 – 68.0	87.0 – 95.5	69.0 – 72.0	10.3 – 10.5
Yearling	F	4 (3)	Mean	30.5	70.9	91.5	70.7	10.2
			Range	30.1 – 31.0	69.5 – 72.0	90.5 – 93.0	70.5 – 71.0	10.0 – 10.3
2½ year	M	6 (5)	Mean	32.1	75.3	95.6	75.3	10.4
			Range	31.5 – 33.3	71.0 – 84.0	91.0 – 100.5	72.5 – 79.5	10.0 – 11.0
2½ year	F	5 (2)	Mean	30.8	71.2	94.8	71.3	10.3
			Range	30.0 – 32.0	65.0 – 76.0	90.5 – 100.5	70.5 – 72.0	10.0 – 10.5
3 year +	M	3 (3)	Mean	32.5	77.3	101.8	78.0	10.6
			Range	31.8 – 33.3	74.5 – 80.0	101.0 – 102.5	77.0 – 79.0	10.5 – 10.8
3 year +	F	6 (3)	Mean	31.0	75.4	95.5	72.8	9.9
			Range	29.9 – 32.0	72.0 – 80.0	92.5 – 97.8	72.0 – 74.0	9.6 – 10.1

*Numbers in parenthesis refer to sample size for total length, shoulder height and ear length measurements. Hind foot and chest girth measurements are presented for all 35 specimens.

TABLE 2. — Whole weights and carcass yield of 35 moose

Age Class	Sex	No.	Whole weight		Carcass yield*	
			Mean	Range	Mean	Range
calf	M	5	435	426 – 456	49.8	46.2 – 56.9
calf	F	4	384	345 – 426	46.5	44.9 – 50.0
1½	M	2	685	644 – 726	49.8	48.3 – 51.2
1½	F	4	741	672 – 782	50.8	46.2 – 53.3
2½	M	6	878	771 – 1039	49.9	47.6 – 51.4
2½	F	5	786	679 – 931	52.5	48.4 – 56.7
3+	M	3	911	794 – 1054	50.2	49.2 – 51.2
3+	F	6	921	899 – 945	50.2	46.7 – 54.1

*Percent of whole weight contributed by the dressed carcass.
Mean for all age classes is 50.0%.

chain hoist from the apex of a portable tripod. Moose and scale were raised by hand with a chain hoist. The weights were not exactly "whole" since the animals were bled immediately after being shot. The amount of blood thus lost was variable, depending upon location of the gunshot wound. Moose weighed in the field were then tagged with a numbered metal tag which was recorded at the abattoir along with other data such as dressed carcass weight. Thus it was possible to determine the percentage of whole weight made up by the dressed carcass. Dressed carcass weights were determined to the nearest five pounds on an overhead track scale in the abattoir. Dressed carcasses had viscera, hide, feet and head removed. The head was usually severed between occipital condyles and atlas. In some cases a small amount of blood-shot meat had to be removed, but the amounts were not recorded.

Measurements of moose were also obtained at the kill sites. Hind foot and chest girth measurements were recorded for all 35 moose for which whole weight was also obtained. Total length, shoulder height, and ear length measurements are available for only the 25 animals weighed in 1963. Measurements follow the definitions of Anderson (1948) and were recorded to the nearest one-eighth inch.

Moose were assigned ages as calves, yearlings, 2-year-olds, and adults by comparison of tooth replacement and wear patterns with photographs and descriptions of Peterson (1955).

All moose were killed between November 24 and January 6, thus year-to-year differences in physical condition are not likely to be great.

RESULTS AND DISCUSSION

Measurements of 35 moose are presented in Table 1, weights in Table 2. Unfortunately, few adult bulls were available. Mean weights of year classes increase until at least 3½ years of age, and perhaps for longer, but the only adjacent age classes showing no weight overlap are calves and yearlings. Although age-class samples in Table 2 are small, they suggest that 1½-year-old females are heavier than bulls of the same age. The three adult (3+) bulls

TABLE 3. — Average dressed carcass weight and estimated whole weight by age class of 261 moose

Age Class	Male			Female		
	No.	Dressed weight	Estimated whole weight*	No.	Dressed weight	Estimated whole weight*
Calf	21	$\bar{x}$ 210	420	27	207	414
		r 155 – 243	310 – 486		155 – 247	310 – 494
$1\frac{1}{2}$	34	$\bar{x}$ 337	674	28	357	714
		r 254 – 426	508 – 852		282 – 410	564 – 820
$2\frac{1}{2}$	33	$\bar{x}$ 410	820	24	424	848
		r 332 – 504	664 – 1008		369 – 470	738 – 940
Adult	39	$\bar{x}$ 485	970	55	452	904
		r 352 – 568	704 – 1136		318 – 531	636 – 1062

*Based on mean carcass yield of 50%.

in Table 2 do not likely present a true indication of the weight of adult bull moose since all were young adults (3½-4½ year old) and it has been reported by other authors (Markgren, 1964) that bull moose increase in weight until 10 years of age.

The percent of whole weight contributed by the fully dressed carcass (carcass yield) varied from 44.9 to 56.9, but age-class means were remarkably similar. Calves showed the most variable relationship between whole and dressed weight. Mean carcass yield for the sample of 35 moose was 50.0%. Part of the individual variation in carcass yield was probably a result of varying amounts of cooling of the carcasses following killing. If all carcasses had been hot when weighed the mean yield would probably have been slightly greater than 50%. It is generally accepted that a hot ungulate carcass loses 2.5% of its weight by evaporation during the first 24 hours it is hung (Ledger and Smith. 1964). Those authors determined means of 57.6% and 56.6% for cold carcass yield of boran steers (*Bos indicus*) and Uganda kob (*Adenota kob*) respectively. Hamerstrom and Camburn (1950) found the mean carcass yield of 24 mixed age and sex white-tailed deer to be 52.5%. Whole and dressed weights of four adult female bighorn sheep (*Ovis canadensis*) presented by Blood (1966) gave an average carcass yield of 53.2%.

The carcass yield of Elk Ilsand moose appears to be slightly lower than that of other wild ungulates. However, were it not for the fact that some shot-damaged meat had to be removed from a number of carcasses, the moose carcass yield would have been slightly higher and more closely approximated that of the other ungulates mentioned. According to Markgren (1964), "The dressed weight of Swedish moose is generally estimated to make up some 55 to 60 percent of the total weight." However, no actual figures are given.

Dressed carcass weights of 261 moose are given in Table 3. Estimated whole weights in that Table were determined by multiplying the dressed weight by two. The calculated whole weights correspond closely to the actual whole weights presented in Table 2, and again the only age classes with no overlap

TABLE 4. — Whole weights in pounds of four races of North American moose

Race	Authority	Male Age	Male Number	Male Mean	Male Range	Female Age	Female Number	Female Mean	Female Range
A. a. andersoni	This study[1]	3+	39	970	704–1136	3+	55	904	636–1062
,, ,,	,, ,,	3+	3	911	794–1054	3+	6	921	899–945
,, ,,	Peterson (1955)[2]	3+	7	997	847–1177	3+	2	762	728–800
A. a. americana	Des Meules (1965)	$5\frac{1}{2}$–$6\frac{1}{2}$[3]	—	1078	—	$5\frac{1}{2}$–$6\frac{1}{2}$[3]	—	822	—
,, ,,	Carter (1963)[4]	$6\frac{1}{2}$	7	968	—				
A. a. shirasi	Houston (unpublished)[1]	3+	20	893	686–1156	3+	7	746	600–852
A. a. gigas	Rausch (1958)	5+	2	1113	1085–1140	3+	11	826	579–995

[1]Dressed carcass weights multiplied by factor of two.
[2]Specimens from Minnesota, Michigan, Alberta, Manitoba and Ontario.
[3]Heaviest age class recorded.
[4]Field dressed weights of heaviest age class multiplied by factor of 1.33.

are the calf and yearling groups. Despite the fact that whole weights in Table 3 are estimated from carcass yield, the age class means and ranges are probably more representative of Elk Island Park moose than those in Table 2 because of the larger samples available. The estimated whole weights suggest that 2½-year-old as well as 1½-year-old females are heavier than males of the same age. This relationship would probably not be apparent in summer or early fall when bulls are in better physical condition. Bulls lose much more weight than cows during the rut and could not be expected to regain much of it by the time they were killed in December. Bulls 3½ years of age and older averaged only about 70 pounds heavier than cows in December, but the differences would probably be greater in summer. Age-specific moose weights (A. a. *americana*) presented by Des Meules (1965) also show 2½-year-old females to be heavier than their male counterparts.

Although large series of moose weights may be recorded in unpublished reports, few comparative data are available in the published literature. Peterson (1955) summarized available North American moose weights and found only 10 authentic weights of adult A. a. *andersoni* and 6 of young animals. Adult weights of the four North American races of moose are compared in Table 4. They suggest that average weight of all four races are similar, but larger samples are needed in some cases. It appears that individual and seasonal differences are more significant than racial difference.

SUMMARY

Whole weights of 35 moose and dressed carcass weights of 261 moose, all killed in early winter at Elk Island National Park, Alberta, are presented. Dressed carcass yield of the 35 moose averaged 50%. Average age-specific whole weights in pounds of 261 moose, based on a carcass yield of 50%, are as follows: (male) calf–420, 1½–674, 2½–820, 3+–970: (female) calf–414, 1½–714, 2½–848, 3+–904. At the time of collection, cows were in better physical condition than bulls.

The Elk Island weights are compared with those of other races of North American moose. Racial differences in weight are not great. Individual and seasonal differences appear to be quite pronounced.

ACKNOWLEDGEMENTS

A great many members of the Canadian Wildlife Service and National Park Service took part in the collection of moose data during herd reductions. We are particularly indebted to D. R. Flook for advice and encouragement, and to H. R. Webster and W. D. Armstrong, formerly Superintendent and Chief Warden respectively, Elk Island National Park, for providing facilities. Dr. James Hatter kindly read this paper in manuscript form and provided critical comments.

REFERENCES

ANDERSON, R. M. 1948. Methods of collecting and preserving vertebrate animals. National Museum of Canada Bulletin 69, 169 pp.

BLOOD, D. A. 1966a. Some characteristics of the moose of Elk Island National Park, Alberta. Canadian Wildlife Service, progress report, project M1-4, typewritten, 22 pp.

———. 1966b. Progress report on bighorn sheep investigations in the Rocky Mountain National Parks. Canadian Wildlife Service, typewritten report, 29 pp.

CARTER, B. C. 1964. The 1963 moose season in New Brunswick. Typewritten report, 6 pp.

DES MEULES, P. 1965. The moose hunters guide. Quebec Department of Tourism, Fish and Game, Technical Handbook, 35 pp.

HAMERSTROM, F. N. and F. L. CAMBURN. 1950. Weight relationships in the George Reserve deer herd. Journal of Wildlife Management, 31(1):5-17.

HOLSWORTH, W. N. 1950. Interactions between moose, elk and buffalo in Elk Island National Park, Alberta. Unpublished M.Sc. thesis, The University of British Columbia, Vancouver.

LEDGER, H. P. and N. S. SMITH. 1964. The carcass and body composition of the Uganda kob. Journal of Wildlife Management, 28(4):827-839.

MARKGREN, G. 1964. Puberty, dentition and weight of yearling moose in a Swedish county. Jaktbiologisk Tidskrift, 2(7): 409-417.

PETERSON, R. L. 1955. North American moose. University of Toronto Press, xii + 280 pp.

RAUSCH, R. A. 1958. Distribution, movements and dynamics of the Railbelt moose populations. Alaska Game Commission, Job Completion Reports, Volume 12, Number 1:28-109.

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FOOD ITEMS IN TWO LOGGERHEAD SEA TURTLES, *CARETTA CARETTA CARETTA* (L.) FROM NOVA SCOTIA

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MARINE TURTLES of tropical origin are of regular occurrence in summer along the coast of Nova Scotia (Bleakney 1965). Of the three species reported, the Leatherback (*Dermochelys coriacea coriacea* Linnaeus) the Ridley (*Lepidochelys kempi* Garman), and the Loggerhead (*Caretta caretta caretta* Linnaeus) the latter is the rarest. There is but a single authenticated report of the capture of a live Loggerhead and that is based on a painting done in 1931 by the late C. E. Johnston, then artist and taxidermist at the National Museum of Canada (Bleakney, 1958, p. 18). That turtle was captured three miles off Devil's Island, Halifax County, and the length of the carapace was recorded as about twelve inches. The original painting, together with a sketch that may or may not be the same turtle, are at the National Museum of Canada, and photocopies are on file at Acadia University and with Archie Carr, University of Florida, who kindly verified the species depicted in these illustrations.

The author has recently examined four Loggerhead Turtles landed in Nova Scotia, and has been informed of others. Most of these were taken by Nova Scotia fishermen in warm Gulf Stream waters from the Georges Bank area and south as far as Cape Hatteras. However, on June 14, 1964, just off Chebucto Head, near Halifax, a live Loggerhead Turtle was hauled aboard a small fishing craft operated by Aubrey Purcell and George Riche. The turtle appeared to be dead but as it was brought over the side of the boat it opened its mouth and hissed. It did manage to turn about on the deck but was generally inactive except for raising its head when touched. The turtle was delivered to the Nova Scotia Museum of Science, and was then killed by a gun shot in the neck, injected with formalin, and a two-piece fibre-glass mold made of the entire animal. Through the efforts of Lloyd Duncanson of the museum staff, this first extant specimen of *Caretta c. caretta* from Nova Scotian waters was delivered to Acadia University for dissection.

The carapace of this female Loggerhead measured 28.5 inches long by 25 inches wide (over the curve of the shell it was 31 by 29.5 inches). The rough and pitted surface was covered with scattered tufts of a rust colored algae (*Polysiphonia* sp.). Both fore-flippers had tattered edges and a number of scales had been torn off and were healing. The extended fore-flippers measured 44.5 inches tip to tip. The plastron was 23.75 inches long and 21.5 inches wide. All are straight line measurements. Unfortunately, there were no suitable scales available for weighing the turtle, but rough calculations put the figure at 110-120 pounds.

The entire digestive tract was 30 feet long, and judging from the amount of *Sargassum* weed in the intestine the turtle had been feeding well, but in warmer waters. There was an entire Atlantic Mackerel (*Scombre scombrus* L.) in the anterior end of the esophagus but the "decayed" appearance of the fish indicated that it was either carrion or had been regurgitated. There were no further contents in the esophagus or in the stomach and the anterior one-quarter of the intestine, but beyond that point there were masses of *Sargassum natans* (L.)J. Meyen, and *Sargassum fluitans* Børgesen. Mixed with these were traces of *Ulothrix flacca* (Dilluyn) Thuret, and *Urospora penicilliformis* (Roth) Areschoug. There was no evidence of local inshore algae such as *Fucus* or *Ascophyllum* which often occur in floating wind racks along the coast.

The *Sargassum* weed in its passage through the intestine, has undergone no appreciable change and it is therefore assumed that the turtle derives very little sustenance from the algae. The nutritional value of this plant to the turtle would be difficult to determine for the digestible fractions can vary considerably from season to season and from one species of algae to another (MacIntyre and Jenkins, 1952). The animal matter taken in was digestable as evidenced by the numerous empty tests (an undigestable cellulose-like substance) of tunicates and the remains of one sea horse, *Hippocampus hudsonius DeKay*. The plates of two species of goose barnacles, *Lepas fascicularis* Ellis and *Lepas anatifera* L., were also located in the tangle of *Sargassum* weed. The most anterior food item in the intestine was portions of a jellyfish but beyond that region no other scyphozoans could be recognized.

Two additional items were found; a chip of wood and a coil of 30 fine strands of 13 inch long pieces of blue fishing line.

The above observations indicate that this turtle was healthy and feeding while recently in a mass of *Sargassum*, undoubtedly associated with Gulf Stream waters. From Munk's discussion (1955) it is probable that large eddies of the Gulf Stream separate and drift away from the main current and these islands could carry a thriving flora and fauna until they finally dissipate and mix with the cold coastal currents of the New England States and Atlantic Canada. Possibly this Halifax Loggerhead became separated from such a thermal oasis and became benumbed to near immobility by our cold coastal water.

On July 5, 1965, a female Loggerhead Turtle was brought to "The Fisherman's Market" in Halifax after being caught 190-200 miles southwest of Nova Scotia, by Mr. Drake on the "Fanny Faye". The surface water temperature at the time of its capture was recorded as 65°F. This specimen (straight line carapace dimensions 20.5 by 17.5 inches) was dissected in November, 1966, and the contents of the digestive tract again indicate a close association with *Sargassum* habitat, for this alga occurred undigested in stomach, intestine and lower colon. The only other plant matter was five small pieces of *Ascophyllum* (not identified to species) scattered from stomach to lower colon. The animal matter was varied and concentrated in the stomach and lower intestine. Unfortunately, some peculiar fish bones could not be identified (pers. com. S. H. Weitzman). Associated with these bones in the stomach were over 20 *Hyperia medusarum* (O. F. Müller) amphipods indicating that the turtle had probably eaten a *Cyanea* jellyfish, and there was some jellyfish tissue present but not identifiable. Two specimens of a second amphipod species *Euthemisto compressa* (Goes), were in this same lot. The only other recognizable item in the stomach was one test of a tunicate.

In the intestine, four more tunicate tests, a cube of wood, plates of goose barnacle and parts of a flying squid (*Onychoteuthis banksi*) were removed from the tangle of *Sargassum.* The squid remains were in the lower colon and consisted of beak, ink sac and two eye lenses.

Judging from the digestive tract contents of these two specimens of Loggerhead Turtles, they appear to be carnivorous feeding indiscriminately on faunal elements associated with *Sargassum* weed and they inadvertently consume algae and miscellaneous pieces of flotsam and jetsam. This is quite in contrast to the activities of the Leatherback Turtles in our northern waters (Bleakney, 1965) for they are active inshore where they prey rather specifically upon the large coldwater scyphozoan *Cyanea capillata* Eschscholtz var. *arctica* Peron & Lesueur.

The author is indebted to Mr. Lloyd Duncanson of the Nova Scotia Museum of Science for being instrumental in having the 1964 specimen preserved for the author's attention. Dr. Alfonso Rojo, of St. Marys University, Halifax, contributed the 1965 turtle. Miss Constance MacFarlane of the Nova Scotia Research Foundation kindly determined the algae species. Dr. Stanley H. Weitzman of the United States National Museum identified the fish remains; Dr. Victor Zullo of the Woods Hole Marine Biological Laboratory the barnacle

plates; and Dr. Clyde F. E. Roper of the United States National Museum the squid parts. Their generous assistance is gratefully acknowledged.

REFERENCES

BLEAKNEY, J. SHERMAN. 1958. A Zoogeographical study of the amphibians and reptiles of Eastern Canada. National Museum Canada Bulletin 155:1-19.

———-. 1965. Reports of marine turtles from New England and Eastern Canada. Canadian Field-Naturalist 79(2):120-128.

MACINTYRE, T. M. and M. H. JENKINS. 1952. Kelp meal in the ration of growing chickens and laying hens. Scientific Agriculture 32:559-567.

MUNK, WALTER. 1955. The circulation of the oceans. Scientific American. Sept. 1955.

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NOTES

Sedum in the Ottawa District*

SPECIES of *Sedum*, commonly known as stonecrop, have been grown for many years as ornamental and particularly as rock garden plants. Some have escaped from cultivation to roadsides, waste places and especially to rocky situations where there is relatively little competition.

Fernald in the 8th edition of Gray's Manual, lists nine species which have escaped from cultivation and become established in the Northeastern United States and adjacent Canada. Of these, only *S. acre, S. telephium* var. *purpureum* and *S. spurium* are known to occur in the Ottawa District, the first two for many years, the last a recent escape from cultivation. A fourth species, *S. hispanicum*, is known in Canada and the Gray's Manual range, from a single collection made in 1964 a few miles southeast of Ottawa.

S. acre L., the Mossy Stonecrop, is reported by Fernald as occurring on "Rocks, walls and dry open places, Que. to Wash. . . ." Boivin (1966) has reported its presence in all the Canadian provinces from Nova Scotia to British Columbia and a literature record from Newfoundland.

In the Ottawa District, it has been collected near the Canadian Pacific Railway Station in Hull, and at Old Chelsea, Wrightville and Tenaga, all in Quebec, and Nepean Point, Ottawa West, Britannia, Mississippi Lake, Lanark, Blakeney, Malakoff, and near the "Burnt Lands" in Ontario. At Britannia this species forms dense patches on piles of finely broken limestone and in crevices of limestone rocks near the Ottawa River shore. The bright yellow flowers make a fine display in late June and early July. James Fletcher, one of the founding members of the Ottawa Field-Naturalists' Club, collected the first specimen on June 28, 1897 from limestone rocks, Richmond Road, 2 miles from Ottawa. The limits of the City of Ottawa are now far west of this site, which has no doubt been obliterated by the expanding city.

Sedum hispanicum L. Data for the only Canadian record** is as follows: Ontario, Carleton Co., Nepean Twp., 11 miles SW of centre of Ottawa, forming several dense stands in shattered sandstone in abandoned quarry, *Cody & Adams, 13237*, 24 June 1964 (DAO). The flowers were almost past at this date.

Sedum spurium Bieb., *S. stoloniferum* of Gray's Manual, ed. 7, is reported by Fernald as occurring on "Rocky or sandy roadsides, banks or old fields, spread from cult., Nfld. to N.Y. and Pa.". Data for the one Ottawa District record is as follows: Ontario, Carleton Co., Nepean Twp., 11 miles SW of centre of Ottawa, small patch 2 ft. in diameter in partial shade in very shallow soil over sandstone at edge of old quarry, *Cody & Kemp, 13279,* 19 Aug. 1964 (DAO). There is one other collection from Ontario (Waubaushene (TRT-Boivin, personal communication)). The only other Canadian specimens are from Nova Scotia (DAO, CAN) and Newfoundland (Boivin, '966).**

Sedum telephium L. var. *purpureum* L., Garden–Orpine, is reported by Fernald as occurring on "Roadsides, open banks or open woods, spread from cult. and abundantly (often aggressively) natzd., Nfld. to Ont. . . .". It is also known from British Columbia (DAO).

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*The Ottawa District is defined as the circular area surrounding the City of Ottawa, Ontario, having a radius of 30 miles.

**Since the preparation of this note, specimens of *Sedum hispanicum* and *S. spurium* have been received for identification from Dr. Albert Legault, University of Sherbrooke. Both species are new to to the flora of Quebec. Data are as follows:

Sedum hispanicum: Bromptonville, canton de Brompton, comté de Richmond, sur rocher (schiste) quasi-dénudé, *Forest 477*.
Sedum spurium: idem., *Forest 476*.

In the Ottawa District there are specimens from Ottawa, Woodroffe, Malakoff, Navan and Carlsbad Springs in Ontario and Aylmer in Quebec. The earliest collection was made by Wm. Scott, another founding member of the Ottawa Field-Naturalists' Club, at Carlsbad Springs on Aug. 7, 1890. This species, which used to be grown in almost every garden, is now but little cultivated because of the ready availability of many more pleasing garden plants.

The following key to the introduced species of *Sedum* found in the Ottawa District is offered:

A. Flowers yellow; leaves ovoid- triangular, to 0.5 cm long .... *S. acre*

A. Flowers white to pink or red-purple; leaves terete or flattened, 0.5 to 8 cm long. .... B

B. Flowers red-purple; leaves oblong or ovate-oblong, 2 to 8 cm long, toothed towards the apex; tall upright plants 20 to 80 cm in height .... *S. telephium* var. *purpureum*

B. Flowers white or pink; leaves blunt-terete or flattened with a cuneate base, 0.5 to 2 cm long; plants to 24 cm in height but usually 15 cm or less. C

C. Stem leaves alternate, oblong-linear, terete, 0.5 to 1.5 cm long, glaucous; inflorescence glandular-pubescent .... *S. hispanicum*

C. Stem leaves opposite, flattened, about 2 cm long, obovate, cuneate to the base, crenate-toothed on the upper part, glandular-ciliate; inflorescence not glandular-pubescent .... *S. spurium*

REFERENCES

BOIVIN, B. 1966. Naturaliste Canadienne 93:630.

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First Record of the Summer Tanager in Ottawa, Ontario

ON MAY 24, 1967, I observed a Summer Tanager (*Piranga rubra*) in the west end of Ottawa, Ontario. I first noted the bird at 2:30 PM and studied it under excellent observing conditions. The Tanager (a male) was exceedingly tame and permitted a very detailed study. About an hour later the sighting was confirmed by W. E. Godfrey, Curator of Ornithology at the National Museum of Canada.

It spent the entire day in a small open wood. Seldom did it rest at a height of more than ten to fifteen feet. There was no lack of food and its day was occupied by catching insects in flycatcher fashion. On one occasion it was seen eating tent caterpillars. Several times it entered a small grove of Red Pines, but mainly it confined its activities to the more open areas of young Red Maples, American Elms and Trembling Aspens.

In the course of the day, approximately a dozen observers studied the bird. It was collected the next day by A. E. Bourguignon of Ottawa and is now in his collection. This is the northernmost record of the Summer Tanager in Ontario and serves as the first record for the Ottawa area.

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Common Terns (*Sterna hirundo*) Nesting at Miquelon Lake, Alberta

SOME observations on Common Terns nesting at Miquelon Lake (Lat. 53°15′ N; long. 112°55′ W) were made in 1964. A total of 63 nests was found on three islands in the lake. The first terns were seen at Miquelon Lake on May 9 and the first egg was found on May 21. The date of commencement of laying was determined to the nearest day in 58 nests.

Eighty-one per cent of the clutches were initiated in the first two weeks of

the laying season. A major time lag in laying occurred from June 6 to June 19. As a result of a declining lake level, the two islands on which the terns nested from May 21 to June 6 gradually became part of the mainland. Another small island emerged from the lake in June and became the new nesting location of the terns. All clutches after June 6, probably renesting attempts, were laid on that island. However, owing to disturbance by cattle and possibly by predators, no young terns were raised on any of the islands in 1964.

Incubation periods were determined from the known intervals between the laying and hatching of the third eggs. From three, five, and two observations, they were 22, 23, and 24 days respectively for an average incubation period of 22.9 days.

Thirty-nine clutches contained three eggs each while 24 clutches had two eggs each for an average clutch size of 2.62. Only 47.3 per cent of the eggs in the 63 nests hatched, mainly owing to loss of eggs from the nests through unknown causes. Most of the chicks disappeared within a week of hatching with only two living longer than a week. Their remains were found some time later bearing the marks of an unknown predator.

ACKNOWLEDGEMENTS

The observations reported above were made incidentally during a study done for the University of Alberta. The manuscript was written while I was employed in the Canadian Wildlife Service. I am obliged to Mr. R. H. Mackay for reviewing the manuscript.

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Elymus sibiricus (*Gramineae*) New to British Columbia

BOWDEN AND CODY (1961) recorded *Elymus sibiricus* as new to the District of Mackenzie on the basis of collections from Fort Simpson and Nahanni Butte on the Liard River, and relegated the newly described *E. pendulosus* Hodgson (1956) from Alaska to the synonomy of *E. sibiricus*. Again, Cody (1963) recorded *E. sibiricus* from several localities in the District of Mackenzie along the Liard River between Nahanni Butte and the British Columbia border.

Along the Liard River in the District of Mackenzie, *E. sibiricus* occurred at the top of, and on the slumping silt river banks, and had in a few instances moved into cabin clearings. When I found this plant here I postulated that it should also be found in similar situations along the Liard River in British Columbia, and I expressed the opinion that it was indigenous to the District of Mackenzie, the same conclusion Hodgson had come to for his *E. pendulosus* in Alaska.

During the summer of 1967, while travelling along the Alaska Highway through British Columbia, I stopped at the crossing of the Muskwa River, a tributary of the Liard River. *Elymus sibiricus* was found in similar habitats to the Mackenzie specimens. This site is approximately 100 miles south of the Mackenzie-B.C. border and 150 miles upstream from the nearest collection along the Liard River in the District of Mackenzie. It appeared to be indigenous along the bank of the Muskwa River.

Data are as follows: British Columbia, Mile 296.6 Alaska Highway, 3 miles SE of Fort Nelson, 58°47'N, 122°40'W, occasional on steep eroding bank of Muskwa River, common where a part of the silt bank had slumped towards the river, and occasional in a disturbed clearing by the river, *Cody & Spicer, 16328*, 16 July, 1967 (DAO); same locality, *Cody & Spicer, 18044*, 13 Aug., 1967 (DAO).

Duplicate specimens have been deposited in the following herbaria: GH, UBC, US, V and Palmer, Alaska.

A detailed description of *E. sibiricus* is given by Bowden and Cody (*op. cit.*). As pointed out it can readily be distinguished from *E. canadensis*, *E. hirsutus* and *E. glaucus* which it resembles, particularly by the short glumes with short awns. The greenish-purplish spikelets are also quite characteristic, and in the field the pendulous nature of the spike is very characteristic although this latter character is not always readily discernible in herbarium specimens. An illustration of this character is given in Hodgson (*op. cit.*).

REFERENCES

BOWDEN, W. M. and W. J. CODY. 1961. Recognition of *Elymus sibiricus* L. from Alaska and the District of Mackenzie. Bulletin of the Torrey Botanical Club 88:153-155.

CODY, W. J. 1963. A contribution to the knowledge of the flora of southwestern Mackenzie District, N.W.T. Canadian Field-Naturalist 77:108-123.

HODGSON, H. J. 1956. A new *Elymus* from Alaska. Rhodora 58:144-148.

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Sea Birds Off Halifax, March, 1967

I WAS THE ORNITHOLOGIST on board CNAV SACKVILLE for the Dalhousie Institute of Oceanography cruise 67-2, between March 6th.-8th. 1967. We went out some 170 miles from Halifax, Nova Scotia, on a SSE course, roughly at right angles to the line of the coast, and we came back by the same route. We covered the same areas in daylight both coming and going, so I shall combine the data from the two.

For convenience, I shall divide the cruise into four areas:

a. Halifax waterfront: the 2-mile stretch of wharves between H.M.C. Dockyard and the ocean terminals.

b. Coastal: from the end of the waterfront out to Chebucto Head, the furthest point of land (c.12 miles).

c. Inshore: from Chebucto Head out to 44°00'N, 63°10'W (c.45 miles). At the southernmost point of this area the ship was just north of the Sambro and Emerald fishing banks. 5 surface water temperatures ranged between −0.1°C and +0.5°C; a sixth, at the southernmost point, was 1.1°C.

d. Offshore: from 42°28'N, 62°24'W to 42°00'N, 62°12'W (c.30 miles). This area is in the Gulf Stream, and the water is correspondingly warmer; 4 surface temperatures ranged between 3.6°C and 5.1°C.

Our course therefore cut across at least two hydrographically distinct areas. I wanted to see how this affected the birds' distributions.

1. THE LARUS GULLS

The commonest species were Herring and Great Black-backed Gulls *Larus argentatus* and *L. marinus*. I also saw 5 Iceland Gulls *L. glaucoides*—3 by the Waterfront, 2 Inshore. I was interested in comparing the distributions of Herring Gulls and Great Blackbacks, and also those of first-winter and older Herring Gulls.

i. Herring Gulls and Great Blackbacks

The two species were distributed as shown in Table I.

I conclude from this that the Great Blackbacks are based on the coast, but fly out to Inshore waters to feed— presumbly on fish. There was, in fact, a movement of these gulls towards the Sambro bank on the evening of March 6th. By contrast, the Herring Gulls are concentrated near the coast, as they are in the Gulf of St. Lawrence (Rees 1963). They may be getting much of their food by scavenging along the shore and water-

TABLE 1.—Counts of Herring Gulls and Great Blackbacks in the observation areas.

	Herring Gull	Great Blackback
Coastal plus Waterfront	289	23
Inshore	84	65
Offshore	67	1

front, as they seem to do in Britain (Brown, 1967; Harris 1965). However, it is curious that they should go so much further Offshore than the Great Blackbacks.

ii. Herring Gulls: proportions of first-winter birds

Phillips (1962) found that in Britain the brown first-winter gulls stayed near the shore, while the white-bellied adults and subadults were also found out at sea. He shows that dark overhead objects are more visible than white ones to fish; whichever is cause and effect, the dark first-winter birds are mainly scavengers rather than fishers. I wanted to see whether the gulls in Canadian waters followed a similar distribution pattern.

I found (Brown, in prep.) that the *Larus* gulls I saw offshore in Newfoundland and Greenland waters were all adults and subadults, although there were first-winter birds in the harbours. My counts on this cruise, which are given in Table 2, show the point in more detail.

The first-winter birds are commonest, not merely close to land, but along the waterfront where garbage must be most abundant.

2. OTHER SPECIES

Fulmar *Fulmarus glacialis*

Like Tufts (1961) and Rees (1961), I found that these were scarce. 7 half-hour transects in the cold Inshore waters produced a total of 4 birds; I saw none in 4 Offshore transects. This contrasts with the transect counts of 20-30 birds I saw in the waters south of Greenland, let alone the counts of 300+ I made off Newfoundland (Brown, in prep.).

Gannet *Morus bassanus*

One adult bird, Offshore.

Kittiwake *Rissa tridactyla*

I found that these were commonest in the warmer waters off Newfoundland (Brown, in prep.), and there is some evidence of this here. 7 transects in the colder Inshore waters produced 0,0,0,2,2, 16, and 17 birds; I counted 50+ birds in the warmer water at the southern edge of this area but the figure may be inflated since they were attracted to trash. 4 transects in the warmer Offshore waters produced 5,7,16 and 27 birds.

In the Newfoundland-Greenland area in April and May I found that adult Kittiwakes were relatively commoner near the coast, and first-winter birds out at sea. On this cruise I had 48 adults to

TABLE 2.—Counts of first winter and older Herring Gulls in the observation areas.

	Adults + subadults	First-winter
Waterfront	87	40 (31.5%)
Coastal	131	31 (19.1%)
Inshore	59	13 (18.0%)
Offshore	56	11 (16.4%)

56 first-winter in the Inshore area, and only 19 adults to 39 first-winter Offshore; the figures are small, but they suggest the same sort of trend.

Large Auks

Two Inshore, and 3 Offshore records. These could have been Razorbills *Alca torda* or Murres *Uria* sp.

Dovekie *Plautus alle*

This was mainly confined to the warmer Offshore waters, where I saw 18 birds; I had 1 Inshore record.

Black Guillemot *Cepphus grylle*

One coastal record.

Starling *Sturnus vulgaris*

Nine birds came on board on the evening of March 6th., at the southern edge of the Inshore area and c.45 miles from land. They left next morning, when we were Offshore.

SUMMARY

This paper describes some counts of sea birds made on an oceanographic cruise out of Halifax, N.S. from March 6th.-8th. 1967. An attempt is made to put the distributions of these birds into an ecological context.

ACKNOWLEDGEMENTS

I am grateful to Dr. W. R. P. Bourne, Dr. I. A. McLaren and R. Pocklington for their comments. These observations were made while I held a National Research Council research associateship at the Dept. of Psychology, Dalhousie University.

REFERENCES

BROWN, R. G. B. 1967. Species isolation between the Herring and Lesser Black-backed Gulls *Larus argentatus* and *L, fuscus*. Ibis. 109:310-317.

——— (in preparation). Sea birds in Newfoundland and Greenland waters, April-May 1966.

HARRIS, M. P. 1965. The food of some *Larus* gulls. Ibis 107:43-53.

PHILLIPS, G. C. 1962. Survival value of the white colouration of gulls and other sea birds. Ph.D. Thesis, Oxford University.

REES, E. I. S. 1961. Notes on the distribution of the Fulmar in the northwest Atlantic. Sea Swallow 14:51-53.

———. 1963. Marine birds in the Gulf of St. Lawrence and Strait of Belle Isle during November. Canadian Field-Naturalist 77:98-107.

TUFTS, R. W. 1961. The Birds of Nova Scotia. Nova Scotia Museum, Halifax.

R. G. B. BROWN

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Accepted August 18, 1967

Alexia myosotis (*Ellobiidae*) in British Columbia

Alexia myosotis Draparnaud 1801, establishes a new molluscan record for the province of British Columbia. This fact was communicated to me by Dr. A. H. Clarke of the National Museum of Canada, Ottawa. Its former range as given by La Rocque in his "Catalogue of the Recent Mollusca of Canada" was "Nova Scotia to West Indies". Recently (Paulson, 1957) it has also been reported from Central California.

In British Columbia it occurs at Crescent Beach, near the city of White Rock, Municipality of Surrey, in a salt marsh with *Triglochin maritima* L. (Juncaginaceae), *Atriplex littoralis* L. (Chenopodiaceae), *Salicornia ambigua* Mich. (Chenopodiaceae), *Distichlis spicata* (Gramineae) *Plantago maritima* L. Plantaginaceae) and *Grindelia integrifolia* DC. (Compositae forming the dominant vegetation.

All specimens were collected by searching the basal portions of plants or by turning over logs and other debris.

Mean dimensions of the twenty largest specimens collected were:

Length: 6.5 mm.
Width 2.5 mm.

A. myosotis is placed in the family Ellobiidae (Pulmonata; Stylommato-

phora) and as such is one of the most primitive true pulmonates.

Morton (1958) makes the following interesting remarks concerning the group (Ellobiidae) as a whole:

> "The headquarters of the modern Ellobiidae are salt marshes and estuarine mudflats, and the largest species live in the tropical Indo-pacific. Waters of muddy estuaries are often turbid and poor in oxygen, and it may have been much easier for molluscs to breathe air with a lung by rising to the surface than to obtain oxygen from the water by gill. The original lung was probably a preadaptation in aquatic ancestors that made land life possible. Other early air-breathing groups such as the Dipnoi and the Amphibia may have acquired their lungs in similar habitats in the same way. The ellobiids themselves are rather unprogressive."

There is no clear evidence to suggest how the population became established. The area does however, have a history of introductions with *Crassostrea gigas* Thurnberg, *Crassostrea virginica* Gmelin, *Mya arenaria* L., *Ocenebra japonica* Dunker, *Urosalpinx cinerea* Say, and *Nassarius obsoletus* Say, being the most important ones.

Only a continuing search will reveal the true extent of its distribution in British Columbia.

References

CARL, G. CLIFFORD and C. J. GUIGUET. 1956. Alien Animals in British Columbia. B.C. Provincial Museum Handbook No. 14.

LA ROCQUE, AURELE. 1953. Catalogue of the Recent Mollusca of Canada. National Museum of Canada, Bulletin No. 129.

MORTON, J. E. 1958. Molluscs: An Introduction to their Form and Function. Harper.

PAULSON, E. G. 1957. Taxonomy of salt marsh snail, *Ovatella myosotis*, in central California. The Nautilus 71(1):4-7.

A. L. GRASS

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Accepted September 20, 1967

Sight Record of Scissor-tailed Flycatcher near Toronto, Ontario

ON SEPTEMBER 19, 1966, I saw a Scissor-tailed Flycatcher, *Muscivora forficata*, circling a school yard in the southern section of the Borough of Etobicoke, Toronto. I was attracted to it first by its repetitive call, described in Peterson (1961) as "ka-leep."

Immediately obvious were its extremely long outer tail feathers. The bird's body size was about that of a Horned Lark, the tail being about two inches longer than the entire body.

When the bird was overhead, the pink under its wings and its light grey breast were evident. After circling the school yard three times, it flew west, where I lost sight of it.

Although Ontario lacks a specimen, J. L. Baillie at the Royal Ontario Museum tells me that there are eight previous sight records for the province.

1. Lucknow—before 1886
   J. H. Garnier
2. Oshawa—June 19, 1941
   Harry Rowhaluk
3. Hamilton—June 17, 1943
   John Outram
4. Toronto—October 4, 1951
   Archie Reid
5. Lake of the Woods—July 3, 1955
   Frank Kelly
6. Harriston—October 25, 1960
   Mr. and Mrs. Hilliard Litt
7. Point Pelee—June 3, 1961
   Robert Mara
8. Whitby—May 21, 1966
   Naomi Le Vay

There are, however, specimens from several neighbouring provinces.

References

PETERSON, ROGER TORY. 1961. A Field Guide to Western Birds. Page 191. Houghton Mifflin Company, Cambridge, Massachusetts.

JOHN LAMEY

383 Rimilton Avenue
Toronto 14, Ontario
Accepted October 15, 1967

Silverside, *Menidia menidia*, and Northern Pipefish, *Syngnathus fuscus*, in the St. John River, N.B.

THE exceptionally low level of the St. John River during the summer of 1965 as a result of the excessive drought made conditions excellent for seining. As a result of numerous seine hauls at Brown's Flat, fifty-two specimens of *Menidia menidia* (Linnaeus) were taken. Identification was confirmed by D. E. McAllister, curator of fishes at the National Museum, and forty-seven specimens were placed in the National Museum while five were retained for the New Brunswick Museum collection.

Scott and Crossman (1959) did not include the silverside among the freshwater fishes of New Brunswick but Leim and Scott (1966) refer to its occurrence in the Kennebecasis River which is a tributary of the St. John near its mouth in which the salinity reaches 22 percent and marine fish occur. Browns Flat is about twenty miles farther up the St. John River.

A specimen of the pipefish, *Syngnathus fuscus*, Storer, was taken in a gaspereau net at Public Landing, Kings County, N.B. on March 10th 1967. This specimen measured 211 mm. A smaller one, 110 mm, was taken in the same net earlier in the year. Public Landing is about eighteen miles from the mouth of the St. John River.

Both specimens are now in the New Brunswick Museum collection.

The nearest records according to Leim and Scott (1966) and Huntsman (1922) are for Bocabec in Charlotte County and Annapolis Basin in the Nova Scotia side of the Bay of Fundy.

REFERENCES

HUNTSMAN, A. G. 1922. The Fishes of the Bay of Fundy. Contributions to Canadian Biology. Number 3:51-72.

LEIM, A. H. and W. B. SCOTT. 1966. Fishes of the Atlantic coast of Canada. Bulletin of the Fisheries Research Board of Canada, Queen's Printer, Ottawa

SCOTT, W. B. and E. J. CROSSMAN. 1959. The Freshwater Fishes of New Brunswick; a checklist with distributional notes.

W. AUSTIN SQUIRES
STANLEY W. GORHAM

New Brunswick Museum
Saint John, N.B.

LETTERS

Editorial Policy of the Canadian Field-Naturalist

I appreciate and wholeheartedly endorse your observations in "The New Natural History" (Canadian Field-Naturalist 81(2), and applaud your decision to include communications on appropriate conservation issues in future issues of this journal. Many readers of the CFN are working hard as individuals to arouse public and governmental interest in environmental improvement, and a lot more should be. Conservationists have to use every possible technique to communicate problems and solutions effectively. We are woefully short of good international, national, or even regional conservation publications, and I think the Canadian Field-Naturalist can and should do its part. Exactly what this role should be, very likely won't be decided immediately. Should the CFN continue to combine science and conservation? If so, in what proportions? Will the Ottawa Field-Naturalists' Club choose to publish a new periodical solely on conservation? What energy and funds will be devoted to "the new natural history" – and where will they come from? These and many other questions will be argued for some time, now that you have taken this new step. I know what sections the Canadian Field-Naturalist I'll be reading first, when the next issues come to Alaska.

December 27, 1967

Robert B. Weeden,
Department of Fish and Game,
State Court and Office Building,
Fairbanks, Alaska.

Nest Record Schemes in Canada

Dr. David Peakall's article in the Canadian Field-Naturalist 81(2): 160-162, though ostensibly about nest record schemes in Canada, was in fact largely an account of the establishment of the North American Nest Record Card Program (NANRCP) in the United States, and was illustrated by the nest record card used by the NANRCP. As the article could be interpreted as having been meant to encourage Canadians to contribute to the NANRCP directly, it is necessary to emphasize that this was not the author's intention. In Canada there are five nest record schemes, one in every major region, which provide coast-to-coast coverage of the country. Dr. Peakall was not asking Canadians to contribute to the North American Nest Record Card Program. Canadians should fill out the nest record cards provided by the scheme responsible for their region.

The publication of Dr. Peakall's article has suggested that there is an urgent need for a blueprint for cooperation between regional nest record schemes (at least the Canadian ones) and the NANRCP, and I would therefore like to make the following points regarding the NANRCP on the one hand and regional schemes on the other.

First, there is certainly a great advantage in having a central clearing house for North America for all data collected on the breeding biology of birds throughout this continent, just as there is for all the banding records. At a time when the

effects of pesticides on breeding success are being studied anxiously, the desirability of this is obvious.

Second, the NANRCP can achieve this aim in two ways: (a) by having naturalists use its own card for nests found in regions where there is no regional nest record scheme (consequently NANRCP cards will not be used in Canada since we have complete coverage), and (b) by copying the cards gathered by regional schemes and transferring the data to computer cards or magnetic tape.

Third, in order to reduce bias introduced by having data recorded in different ways by different regional schemes, a meeting of representatives of all existing regional nest record schemes, ornithologists who are authorities on nest record analyses, and data-processing experts, should be convened which, among other things, would design an essentially uniform nest record card for use by all regional nest record schemes as well as the NANRCP, though the name at the top of the card would differ according to the region. In this regard I must point out that the NANRCP card illustrated in Dr. Peakall's article fails to extract the maximum information from the observational situation: examples are that there is no specific slot for information on the reasons why a nest failed or the eggs failed to hatch, nor for the direction in which a mountain slope faces — features which were included on the first card designed for the British Columbia Nest Records Scheme back in 1955. At the same time it is necessary to recognize that if data is to be transferred to computers for analysis changes in the design of nest record cards to facilitate this will probably be desirable.

Fourth, the fully-computerized NANRCP facility housing all North American data will make it possible for data on the reproductive biology of a species to be analyzed as a whole for its entire range in one computer operation. Furthermore, computer programs will have to be prepared for all standard analytical procedures relating to a nest records analysis, so that once a program has been run once only minor modifications would be needed to carry out the analysis again on another species. I would suggest that, in return for the contributions of the regional schemes, the NANRCP should, for the benefit of all concerned, publish as soon as possible a *Handbook of Procedures for the Analysis of Nest Record Cards* giving techniques for hand analysis as well as for computer programs (liaison with the British Trust for Ornithology would be most profitable during the preparation of this book). It would also stimulate contributions if the NANRCP were to produce an information news bulletin which would be sent to all active contributors, whatever their affiliations.

Fifth, at present no guidelines have been established for a business-like relationship between the NANRCP and the regional schemes. Because the use by the NANRCP of data collected by regional schemes can be a sensitive matter, the NANRCP will need to establish a precise understanding with the organizers of regional schemes, and the local university, museum and amateur ornithologists who will make greatest use of the regional data, on what each may do with the data collected. This matter must also be dealt with by the meeting proposed earlier. The agreements reached should be included in the *Handbook of Procedures* so that, as regional organizers come and go, new incumbents know what the arrangements are.

Sixth, some problems already need immediate attention. One is that regional schemes must have the right to withhold from the NANRCP any cards for locally rare or endangered species (such as birds of prey) whenever the local committee should deem this necessary, and the local committee must be satisfied that the

NANRCP will, upon demand, withhold access to the cards of any species which have already been copied. The other is that the proposed meeting of representatives must establish clear-cut rules which will ensure that there is no unwitting overlap between analyses being done by the NANRCP and by ornithologists at the regional level, e.g. that a graduate student doing an analysis at Cornell University does not simultaneously use cards which are being analyzed by another student, or an amateur naturalist, at the regional scheme headquarters – thereby leading to personal and professional conflicts. In this regard priority of statement of intention to use certain cards may be the deciding factor. Or it may be considered that the regional analysis should generally have priority in cases involving certain types of data (e.g. regional distribution and habitat data) and the NANRCP have priority in analysis involving other types of data (e.g. quantitative analyses of hatching and fledging success over a period of years as related to climatic changes or environmental pollution). Finally it will be necessary that anyone wishing to carry out an analysis must have his plans approved, and that normally anyone carrying out an analysis of regional data should also be able to call on the NANRCP for copies of cards, within the limitations just outlined. Dr. Peakall has indicated that the NANRCP would probably also then be able to provide computer facilities as well. The NANRCP must not appear to become a private monopoly of graduate students of Cornell University, but rather be a collection and operation ready to assist any *bona fide* ornithologist anywhere who is interested in making a serious study of the available information.

Seventh, there must be one or more decision-making bodies which will review applications to carry out studies using nest record data either using regional data only or using NANRCP facilities. I would suggest that the proposed meeting of representatives of regional schemes might set up such a Standing Committee for this and other purposes.

To conclude discussion of the NANRCP and its relationship to the regional nest record schemes, let me point out that the NANRCP is *already* copying cards from regional nest record schemes without having established any firm procedures and safeguards of the kind here deemed necessary. It would therefore appear to be urgent that the Laboratory of Ornithology at Cornell University convene a meeting of delegates from regional schemes as here suggested as soon as possible, so that these arrangements can be made.

Let me now explain the role of regional nest record schemes and particularly their importance for the growth of our knowledge of birds in Canada. Regional nest record schemes can do several things that the NANRCP can not do because the latter lacks local perspective and grass-roots.

First, the most important use for regionally collected data is to augment existing knowledge of the breeding distribution of birds within the region, both in terms of expanding and contracting ranges and in terms of local habitat preferences. Regional nest record schemes thus have enormous value for faunal and zoogeographical studies, particularly in Canada where species distributions are still very imprecisely known.

Following from this, regional nest record schemes must provide the information needed for any future upgrading of the books that are the authorities on the birds of each region. There is as yet almost no volume devoted to the birds of a province of Canada that reaches the required standard in describing the population biology and reproductive habits and behaviour of the birds of that particular region because this information has not yet been assembled in one place, and it will remain unavailable until nest record schemes and local naturalists' societies provide it. The

Canadian regional nest record schemes are vital in collectively organizing the efforts of naturalists in this sparsely-populated land. It is important that the NANRCP must do nothing that would lead to the five existing regional nest record schemes in Canada having to close down because of misplaced loyalties or divided efforts among their supporters.

Second, if the truth were out, it is possible for nest record schemes to flourish effectively only if the amateur contributors feel that they have personal contact with the organizer and with each other (like banding, healthy inter-personal competition boosts continuity in contributions, and quality as well as quantity). For most naturalists, the essential pleasure of making a contribution lies in the comradeship that is possible, and this is possible only with a regional scheme, not with an impersonal nation-wide scheme in which the local contacts, and local benefits from contributing, are absent.

Third, detecting unintentional bias by individual contributors is one of the main headaches of anyone analyzing nest record cards for scientific purposes, whether these be biological of faunal. Such biases will be virtually impossible to detect in an all-embracing continent-wide program. To be of value in providing accurate information on regional species biology, nest record schemes must have an organizer (preferably a member of the staff of a provincial museum) who knows a high proportion of his contributors personally (or through frequent correspondence), so that he can pass his knowledge of them on to anyone making an analysis of the cards — otherwise quite unintentional biases will not be identified and compensated for.

Fourth, the filling out of a nest record card is one of the best forms of training that a beginning naturalist can partake of, because it requires that he record accurately. Consequently regional nest record schemes have almost as much of an educational function as a scientific one. This suggests that they should preferably be organized from, and housed at, a provincial (or state) museum in cooperation with the local naturalists' societies. Unfortunately, although most of the five Canadian schemes have slight official connections with educational or scientific institutions of one sort or another, none are as firmly established as they ought to be, and none are officially-sponsored. Periodically a crisis occurs in the management of a regional scheme, most frequently when the individual most active in organizing it moves to another city or region. The naturalists of Canada alone can prevent this, so they should take more coordinated and effective steps to establish a permanent home for their regional schemes, since these are an expanding source of knowledge of very great value for future studies of the birds of each region.

As one who has had a good deal to do with the establishment of the nation-wide network of nest record schemes that we have in Canada, I want to end by affirming once again my faith that these are essential for the future growth of Canadian Ornithology. While we can welcome establishment of the NANRCP in the United States, guidelines must soon be established for the proper conduct of business between this organization and the regional organizations that already existed when it was set up a year or two ago. I hope that this statement of some of the problems that exist may hasten the development of these ground-rules for co-existence.

October 29, 1967

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Calgary, Alberta.

NEWS AND COMMENT

The Nature Conservancy of Canada

The Nature Conservatory of Canada (NCC) is a new symbol in Canada: it was formed in 1963 to extend to Canada the advantages of a conservancy programme. This type of programme had long since been in operation in England, where the Nature Conservancy of that country supervises 112 national nature reserves representing a quarter of a million acres of the natural scene. In the United States, the Nature Conservancy through thirty-one chapters or regional branches had acquired by gift or purchase up to the year 1965, two hundred and one natural areas in thirty-one States, representing sixty thousand acres.

The objective of the NCC is to preserve areas known as natural areas. These are as varied as Canadian topography. Their basic importance stems from the fact that if a particular area was ruined, a segment of the original landscape of Canada would disappear forever. As an example of the NCC's early efforts, the Trustees were alerted to the hazard affecting an area of pre-Columbian forest. This original woodland had been in the hands of the same family since the country was first pioneered. It was covered with cedar, hemlock, ash, pine and elm, three hundred or more years old. The owner, then in his 91st year was persuaded to sell to the NCC: a public-spirited citizen donated the money for the purchase, and the property was saved from a wood-cutting operation.

At this writing, negotiations are under way to acquire 3,000 acres of bog, known for its rare orchids, wild flowers, and bird life. Action is being taken at the right time: a few years hence could find the bog beyond purchase.

The NCC (a Trustee-governed organization) was formed in 1963 under the laws of Canada. It has been in touch with individuals or groups who have sought its co-operation to preserve natural areas for all time. These activities are in evidence from the Atlantic coast line to British Columbia and indicate that the NCC is moving speedily to complete the first phase of its programme. Three questions may be asked. How did the NCC get its start? Where did the NCC get the funds to make land purchases? Where does it hope to obtain future funds for its requirements? In answer to these questions, the sum of $80,000 was subscribed for the purchase of the Rattray estate near Port Credit, Ontario. As events transpired, the upswing in land values of the area made it impossible to acquire the estate and marsh. Those who had subscribed funds toward the purchase of the Rattray property were sent a mailing which included an audited statement of the NCC's financial position, also a mailer card on which each subscriber was asked to indicate if the donation toward the Rattray estate could be used for other purchases, or should the money be returned. Two subscribers who had actually donated $50,000 gave the NCC permission to use this money for the purchase of other property. 97% of all other recipients of the mailing did likewise. Quite a number of these people sent in cheques in further support of the NCC.

The Nature Conservancy of Canada requires money to buy as many areas as possible, and to cover its modest organizational budget. Response has been encouraging. The Canadian National Sportsmen's Show granted the NCC the sum of $3,000 in 1967 for this purpose. Other funds are expected from charitable foundations and other sources. A folder produced by the NCC and descriptive of its objectives, is producing additional donations from persons willing to help.

The NCC works in harmony with all other outdoor groups and Government Departments interested in the preservation of the natural landscape. There is no

conflict or overlapping of effort as far as the NCC is concerned. It is of particular interest that certain areas can be purchased in collaboration with a regional conservation organization: where this occurs, a grant of 75% can be obtained by these organizations providing that the other 25% is subscribed by the NCC. Accordingly high priority areas can be purchased on the basis that every dollar subscribed by the NCC actually becomes four dollars for the acquisition of the land.

The immediate future will be fruitful for the NCC efforts. It is anticipated that its achievements and activities will bring in many new offers of land, either as gifts or to be purchased, and also offers of money. In the meantime, every dollar invested in the Nature Conservancy of Canada goes toward the purchase of natural land areas throughout Canada for the benefit of the present as well as future generations.

January 6, 1968

Charles Sauriol,
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TEXT OF THE DUKE OF EDINBURGH'S ADDRESS TO THE CANADIAN AUDUBON SOCIETY[1]

FOR ANYONE WHO is the least bit interested in birds or who feels at all concerned about the conservation of wildlife in general, an invitation to be a guest at a dinner given by the Audubon Society is an honour indeed, and a very great pleasure. There can be few conservation organizations anywhere in the world with a more impressive record than your Society.

As some of you may have gathered, the main purpose of my visit to Toronto is in connection with the opening of the Royal Agricultural Winter Fair, one of the great agricultural shows of the world; and linked with this is a Conference of the Royal Agricultural Society of the Commonwealth. The Winter Fair is 39 years old; the Royal Agricultural Society of the Commonwealth is 10 years old. Its membership consists of the leading agricultural and show societies of all the Commonwealth countries, and there are 19 of them attending. The subject for this particular Conference is "Engineering in Agriculture". Now, I mention this because it is becoming painfully obvious that, unless the major land users – that is the agriculturalists of all kinds, the farmers, land reclamation and irrigation commissions, the foresters, the mineral developers, water and power engineers, the city and highway planners – until these can be convinced of the need for a sensible conservation policy, the work and the ambition of the most energetic conservation societies will be brought to nothing.

Now, in my experience, people quite naturally look at things from a purely personal and selfish point of view until some other convincing argument is put to them. It was not so very long ago that we all thought the different vested interests in the countryside in Britain, for instance, were wholly incompatible. We all thought that the differences between them in their outlook was so great that nothing could be done to bring them together. But the situation was getting serious – was getting out of hand – and for the limited land area available there was competition from farmers, water boards, climbers, campers, walkers, caravaners, games players,

[1]The address was given at the annual meeting of the society held at the Inn on the Park, Toronto, November 8, 1967.

shooters, hunters, bird watchers, sailors, motor boaters, skin divers, fishermen, butterfly collectors, water skiers, foresters, and several others; and they were all in competition for a very limited supply. So we organized a conference[2] and to everybody's amazement there were no rude words, there were no accusations, and there were no counter-insults. It very soon became apparent that, with a little give and take, and a genuine attempt to appreciate and understand the needs of different groups, these apparently widely divergent factions found it possible to agree to co-operate. Without this co-operation every group will suffer by default, and the cause of conservation will be irretrievably damaged if not lost altogether. With co-operation and understanding any sacrifices which have to be made are at least in the general interests of conservation as a whole, and each interest will get its fair share.

Well, none of this can be entirely free from either emotion or self interest. The wholesale condemnation of pesticides of all kinds is no more sensible than the indiscriminate use of the argument that the starving millions must be fed. There is a very important place for the proper pesticides properly used. The starving millions must certainly be fed, but the total subjugation of all farming land in the advanced countries to uncompromising chemical and mechanical techniques won't achieve this. We can't even arrange the distribution of existing surplus production, and not even the most rudimentary of modern methods have filtered through to the vast farming potential of the underdeveloped countries. In any case, the whole problem of starving millions in the future would be very considerably reduced if we could begin to control the population explosion. The manufacturers of pesticides and agricultural equipment do not have the monopoly in concern for the problems of undernutrition and malnutrition. In my experience, most people who worry about conservation can also claim the same humanity and the same compassion. That isn't the point. We've got to get the problems and the solutions into the right perspective. And the fact is this — that, for the first time in history, man has got complete control over his habitat.

We can, if we so wish, or if we just let things slide, grossly overpopulate the earth.

We can, if we so wish, pollute the land and the water and the air.

We can, if we so wish, exterminate any or all animals which might get in the way of our farms or our cities.

We can, if we so wish, convert all the jungles and the deserts and the swamps and the mountains into some form of usefully productive land. I dare say we could grow strawberries on the top of Mount Everest if we really tried.

We can, if we so wish, cover the whole landscape with concrete to give all the motor cars a chance to drive about at the same time.

If we can do all these things, surely we can decide what sort of habitat we would like to live in first, and then make plans and arrangements to achieve it. I don't aspire to speak for anyone else, but I know what sort of habitat I would like to see. First I would like to see a stabilized world population so that we need make no further demands on land resources. I would like to see farming techniques in all countries developed in sympathy with the needs of wildlife populations, but to the point where no one need go hungry. I would like to see all land users show reasonable concern for the consequences of their plans so that mankind's needs for food and power and water, highways and cities can be met without unnecessary or

[2]The Countryside in 1970 Conference. The proceedings have been published in book form by the Council for the Preservation of rural England—Editor.

avoidable destruction or dislocation of wildlife populations and the balance between them. We have the power to do all these things now, but we cannot do them until more people come to understand what is happening to the world's wildlife and come to see the vision of what the world could be like and until there exists a general will and determination to get it. This, in my opinion at least, is where conservation societies can play such a vital part.

The Audubon Society already has a splendid record, and I am sure it will extend its activities in the future. Perhaps the most encouraging development in recent years has been the formation of the World Wildlife Fund, a fully international organization to which many nations make contributions – and I'm hoping that perhaps even Canada, too, might consider forming a national appeal for the World Wildlife Fund in the near future. The important point is that these Societies should not operate in the narrow sense of trying to keep everything as it was, but in the more constructive sense of pointing the way to a better future and helping to create it. It's not reasonable to expect hard-working farmers or hard-pressed engineers to visualize their activities as part of the broad sweep of human existence automatically. Life is too short. The day-to-day demands and problems are too immediate. The short-term aims of greater productivity, greater profits, and more land under cultivation are more obvious. But this does not mean that they will reject the case for conservation out of hand. After all, they're sensible, intelligent people, and they will respond to sensible, intelligent argument, and it's up to the conservation societies to make the approaches and to put their case moderately but with force and conviction. As I expect you will have noticed by now, I think they have a very good case indeed.

There are many problems and situations which afflict the world over and over again. There will always be poverty and oppression, hunger and lack of opportunity in some corner of the world. There always has been and there always will be. These are recurring problems requiring continuing solutions. But conservation is dramatically different. It really is a case of now or never. Wildlife, whether in the shape of birds, mammals, fish, or plants, is being threatened and eroded as never before in history. If we don't get the answers right now, there won't be a second chance. And this, our generation, will go down in history as the people who failed by neglect and indifference to take decisive control of our environment for the benefit of our successors in the future. Of course, we may all be dead by the time the full horror of our neglect becomes apparent. But I for one do not relish the idea of my grandchildren asking me, "What went wrong?"

Alberta Bison Moved to Quebec

CLEARBROOK GAME FARMS General Manager Herb Kugler reports that 25 bison delivered from Elk Island National Park, Alberta, to his Ormstown, Quebec, farm are "doing extremely well in their new surroundings".

The herd of 22 cows and three bulls was the first sale of buffalo to private enterprise since the National Parks Service took over management of the almost extinct bison in 1908. The slightly bewildered plains bison set foot in Quebec on November 28 after a 78-hour train ride from the Alberta park.

The buffalo, weighing between 1,200 and 1,800 pounds each were purchased by Clearbrook Game Farms on a tender call for $410.00 per animal. National Parks officials report 16 of the 22 cows are in calf.

Joe Azaria, owner of the 500-acre game farm and president of the recently formed Canadian Buffalo Association said that the commercial buffalo ranching

aspect of this venture does not enter into the picture for a long time. "Clearbrook's immediate aim is to breed a sizeable herd for conservation – a program I expect to take from between five to eight years to accomplish" Mr. Azaria said.

On their long trip from Elk Island National Park, the bison were accompanied by Mr. Kugler, who is the man responsible for the breeding and well-being of all the game farm's animals. Mr. Kugler flew west a number of days prior to the shipping day to observe the animals in their old habitat before boarding the freight train with them.

After several days in their specially fenced wintering area, Clearbrook Game Farms report that all animals are in excellent condition.

Ormstown is located about 35 miles southeast of Montreal. The public is welcome to visit the game farm and see the buffalo.

Press Release,
Department of Indian Affairs and
Northern Development,
Ottawa, Ontario.

IVORY-BILLED WOODPECKER, FEARED EXTINCT, SIGHTED

IVORY-BILLED WOODPECKERS – spectacular red, white and black birds of the Southern swamplands that ornithologists had long feared extinct – have been found in Texas. Three pairs of the 20-inch birds – as big as crows – have been sighted in the Neches River Valley in the Big Thicket country of eastern Texas by John V. Dennis of Leesburg, Va., America's leading expert on woodpeckers. Mr. Dennis, who searched for the woodpeckers under a contract with the Interior Department, estimated on the basis of his study and reports from amateurs that there are five to 10 pairs in the Big Thicket.

The last previous confirmed sighting of an Ivory-bill, America's largest woodpecker was of one bird on the Chipola River in Florida in 1950. Since then there have been occasional reports of Ivory-bills, but ornithologists have dismissed the sightings as mis-identifications of Pileated Woodpeckers. Now, Mr. Dennis said, the reports of the amateur bird-watchers cannot be so easily brushed aside as "phony".

Secretary of the Interior Stewart L. Udall said that reports of Ivory-bill's survival would be investigated along the Congaree River in South Carolina, along the Apalachicola River in Florida, along the Tombigee River in Alabama and Mississippi and along the Altamaha River in Georgia.

Mr. Dennis saw his first Ivory-bill in the Big Thicket early last December, about a week after his field study began. He was alone, walking through a cypress swamp, when he spotted the bird on a tree only 50 or 60 feet away. Mr. Dennis was carrying his seven-power binoculars, so he had no difficulty in identifying the bird as an Ivory-bill, with its shiny black and white plumage and long ivory bill. Male birds wear a brilliant scarlet crest.

The Interior Department expressed the hope that curious persons would not try to find the Ivory-bill, and for that reason the exact spot of sightings was not disclosed. Mr. Dennis said, however, that the chance of an average person seeing the birds was "almost zero" even if he were given specific directions. The birds live in the deep swamp, he explained, are wary and are "nomadic – they don't stay put."

With all his expertise Mr. Dennis saw no nests. Nor did he take any pictures

Dr. Dennis would not speculate on the possibility of preventing the Ivory-bill from becoming extinct. He said it would be a mistake to believe that there were fewer Ivory-bills than the approximately 50 whooping cranes known to exist.

One of Mr. Dennis's findings raised hope that the Ivory-bill would survive. Ornithologists have long attributed the species' decline to the disappearance of hardwood forests, where the Ivory-bill fed on larvae of wood-boring beetles. Mr. Dennis, however, discovered that the Ivory-bill also fed on insects in pine slashings, indicating that the bird might be adapting to the changed environment.

Harry Goodwin, Chief of the Office of Endangered Species of the Bureau of Sports Fisheries and Wildlife, has asked timberland owners in the Big Thicket to help preserve the Ivory-bill. Although there has been a campaign to make the Big Thicket a national park, Mr. Goodwin said that he was not asking that the Government acquire the land. Mr. Goodwin is, however, asking timberland owners to rotate their cuttings of pines so there always will be a supply of branches to feed on. The lumbermen are also asked to leave pockets of cypress in deep swamp, which are uneconomical to cut anyway, and to leave some of the older trees standing in other areas for nesting.

In addition, Mr. Goodwin said, the East Texas Wildlife Federation has promised to patrol 100,000 acres it controls in the Big Thicket to prevent shooting of the Ivory-bills. Federal law provides for a maximum penalty of $500 in fine, 60 days in jail or both for injuring an Ivory-bill.

The New York Times,
Sunday, August 27, 1967.

NEWS BRIEFS

Saskatchewan Natural History Society Conservation Award

THE CONSERVATION AWARD of the S.N.H.S. for 1967 was presented to Dr. Stan D. Riome, Nipawin, Saskatchewan, at the Annual Meeting of the Society on October 14. This award is presented annually to a person who has made a significant contribution to conservation in the province of Saskatchewan. Dr. Riome was instrumental in establishing a memorial wildlife sanctuary on the banks of the Saskatchewan River northeast of Nipawin. The land for the sanctuary was transferred from the Department of Agriculture to the Department of Natural Resources and leased by the Saskatchewan Natural History Society. The sanctuary was established in honour of Mr. Maurice Street, a well-known Nipawin country naturalist who died in October, 1966.

Natural Park and Outdoor Recreation Scholarships Offered

SIX SCHOLARSHIPS VALUED at $2,000 each will be awarded for graduate work in planning and management of natural park and outdoor recreation areas by the National Parks Service of the Department of Indian Affairs and Northern Development. The scholarships will be offered to Canadian citizens and are tenable at Canadian universities. Applications will be received by the Director, National and Historic Parks Branch, Department of Indian Affairs and Northern Development, 400 Laurier Avenue, West, Ottawa, until May 15, 1968. Information on degrees held, course of study, and career plans must be included. The awards will be announced in June 1968.

REVIEWS

The Mammals of Eastern Canada

By Randolph L. Peterson. Oxford University Press, Toronto, Ontario. October 20, 1966. $15.95. 645 pages; 107 maps; 233 figs., bl. and wh.; 8 color plates.

Guides to the mammals of British Columbia, Alberta, Saskatchewan, Keewatin, Manitoba, and Ungava have been published in recent years. Now Dr. Randolph L. Peterson, Curator of Mammalogy at the Royal Ontario Museum presents us with a volume treating one hundred and twenty-two species of mammals from Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and the islands in James Bay and eastern Hudson Bay.

Introductory chapters include titles such as, "Mammals and Man," "The Class Mammalia," "The Origin and Classification of Mammals," "The Mammalian Skeleton" and "The Region of Eastern Canada." There are keys, that enable a reader to identify specimens to order, genus, and species. In each species account comments are made on such subjects as, the size, distribution, habitat, habits, population trends, hibernation, economic importance, and conservation. Selected literature references are given for each species. Most species accounts are accompanied by a line drawing of the animal; drawings of the dorsal, ventral, and lateral views of the skull, and of most importance, a distribution map. Eight color plates of 26 species are bound in the center of the book.

This book fills a definite need and will undoubtedly find its way to the shelves of many amateur and professional biologists. The book has many shortcomings though none so great as to discourage its purchase by a prospective buyer. What I consider the most serious faults are offered below in constructive criticism.

The introductory chapters appear to have been written for a general text in mammalogy. They are hazily focussed on eastern Canada. The chapter titled, "Mammals and Man" mentions domestication (dogs, swine, Egyptian cats) coursing, animal husbandry, vivisection, wildlife management (in general) and disease transmission, yet little is related to eastern Canada. Surely in a book of this nature the emphasis should have been on the area covered. The whaling and sealing industries and federal and provincial Wildlife management programs are only a few facets that could have been directly related to our understanding of the natural assets of eastern Canada. The chapter titled, "The Region of Eastern Canada" is disappointing in its biogeographic content. Mention of some of the factors contributing to the distribution patterns of mammals – glacial, topographic, migrational, introductions, climatic, and vegetational, would have added much to an understanding of the distribution maps.

This book was written over a long period, as the abundance of references to pre-1960 publications demonstrates. Some of the ecological information is outdated, and at least a few of the post-1960 "Selected References" only found their way as far as the "Bibliography."

There are some errors in the range maps. The maps have black dots at localities from which specimens are known, and open squares representing records not documented by specimens. Two patterns of overlay are used on many maps indicating former and present ranges of the species, however nowhere in the text is there an explanation of the meaning of the two overlays. The dots representing specimens are not documented. The author explains that to document these localities, "would perhaps double the size of this volume." He makes it clear that this information is available to readers who wish to write to the Royal Ontario Museum. In my opinion the value of the book would have been enhanced if at least the mar-

ginal distribution records of each species had been documented.

The range of the White-tailed Deer is shown as occurring on the Island of Newfoundland, and in the Labrador South District as far as the north shore of Hamilton Inlet, though this species does not occur in either of these areas.

Caribou are shown to be absent from Coates, Mansel, and the Belcher Islands, however they presently occur on Coates Island and formerly occurred on Mansel and Belcher Islands. Avalon Peninsula on the Island of Newfoundland is shown in the former range of the Caribou, however there is at present a large herd on the Southeastern Peninsula.

The use of an overlay for the range maps of whales should have been avoided thus eliminating some of the strange and unbiological "ranges" portrayed on pages 346, 348, 353, 356, and 368.

There are also some discrepancies between some of the ranges as described in the text and those plotted on the range maps. These are not serious and probably result from an attempt to update range maps shortly before publication.

The illustrations are uneven, which is not surprising, since five artists contributed drawings and paintings. The drawings of skulls appear to be accurate although many of the line drawings of mammals are unsatisfactory. There is much duplication between the line drawings and the color paintings. Many of the figures are merely reversed for the paintings. (Big Brown Bat, Red Bat, Hoary Bat, Gray Fox, Red Fox, Arctic Fox) or unchanged (Red-backed Vole, Rock Vole, Mink, Marten) or only slightly changed (for instance by the addition of a leaf in Eastern Phenacomys).

The book is heavy, sizeable, and expensive. It is perhaps excessively padded. The "Table of Contents" gives the orders, families, species, and subspecies, (English and French vernacular names, and scientific names) with type localities. The table of color and line illustrations list each illustration with the scientific and vernacular names of each species. The list of distribution maps also gives the common and scientific names of each species, and the list of tables gives the full title of each table! These lists and the excessive number of totally or partially blank pages eat up forty pages. In addition much of the introductory section is set in very large type.

The criticisms in this review are not meant to downgrade the value of this book. The author has performed a great service by bringing much scattered data together. The accounts of many species reflects an intimate knowledge of the animals in the wild. The distribution maps will be of great use to the professional. One of the greatest functions of the volume is that it stresses how much fundamental "backyard" research still needs to be done in Eastern Canada. This volume will be a necessity to many biologists and will be a valuable addition to many libraries.

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The Alien Animals

By GEORGE LAYCOCK. The Natural History Press, Garden City, New York. 240 pp. $5.95.

The book is primarily designed to bring into focus the results of man's meddling with the natural environment. Although providing evidence about the obvious blunders of man regarding most transplants the author has not taken the opportunity to be too critical of the people responsible for such transgressions. His choice is perhaps the right one for so long as there are people in responsible places able to justify introductions of exotic species on the basis of a human need, however remote, then the pollution of the natural habitat will continue and a more forceful and organized appproach will be necessary.

Research in many fields of wildlife biology has produced information on the distribution of all the endemic forms of animals throughout the world. Much of this information is of historical interest only as we have now, and in a very short time, so polluted our respective countries with exotics, no matter how aesthically attractive they may be, that our native environment will soon be alien.

Man's development is not measured by his degree of economic gain and yet almost every transplant has this element somewhere in the background. Added to this is the ethical hypocrisy which justifies transplants on the basis of providing "sport" for today's generation. In some cases the transplanted species has a higher productivity than indigenous forms and the increased production is necessary as food, but this can hardly be justified in the North American continent.

This book is reasonably priced and although the paper quality is not very good, the printing is large and easy to read. The cover and binding are substantial. The author has provided a substantial bibliography and an index.

Although many of the facts concerning the introduction of non-native species are available elsewhere and should by now be common knowledge, the author has brought them together in a well-written book which is recommended to anyone concerned about transplants of exotic species and their effect on the native flora and fauna. He has omitted, inadvertently, any mention of introductions in Canada, possibly because they do not yet have the same impact on the native fauna as elsewhere. Needless to say, we should not become complacent about this very serious matter as we undoubtedly have well-meaning but misguided individuals capable of the same transgressions.

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Handbook of Northwestern Plants

By HELEN M. GILKEY and LA REA J. DENNIS. Corvallis, Oregon. Oregon State University Bookstores Incorporated. 1967. 505 pp. $7.00 (US).

This book, an outgrowth of an earlier one by the senior author, will greatly help residents of Oregon and Washington, west of the Cascades, and extreme southwestern British Columbia to identify trees and shrubs and the showier herbaceous plants. Unfortunately Cyperaceae, Gramineae, Juncaceae, Najadaceae and Sparganiaceae are keyed only to family level and the reader is then referred to other floras. What other floras to use is a good question. Until the monocotyledons are treated in Vascular Plants of the Pacific Northwest, only Vol. 1 of Abrams will serve the whole area, and it is somewhat dated. This omission is doubly unfortunate: it discourages the amateur from learning his way about these important plants; and it deprives us of a single-volume flora of the region in which the next International Botanical Congress is to be held.

Within its scope the book will probably be easy to use, but only trial will tell how well the keys serve. Descriptions appear generally to be adequate and some species are illustrated. There is an adequate glossary at the back; and three pages of diagrams at the front show leaf shapes and margins, flower parts and inflorescences.

Sampling of several genera reveals a few omissions and a number of doubtful or frankly erroneous names. For example, only *Lithophragma parviflorum* (as *parviflora*) is included, but *L. glabrum* occurs throughout the area, and *L. affine* and *L. campanulatum* reach southwest Oregon. *Tellima odorata* is surely a synonym of *T. grandiflora*. The plant listed as *Saxifraga arguta* must be called *S. odontoloma*; the type of *S. arguta* is referable to *S. punctata*, almost certainly to a population from King William Sound, Alaska. *S. lyallii* is omitted but occurs in northern Washington west of

the Cascades. *S. vespertina*, included as a variety of *S. bronchialis*, is a distinct species. *S. bronchialis* ssp. *austromontana* is omitted but occurs in the Olympic Peninsula and lower Columbia River. The first four listed species of *Montia* were returned to *Claytonia* in Swanson's recent treatment. *Lilaeopsis occidentalis* is stated simply to occur on muddy lake shores, but it is chiefly a coastal plant of brackish flats. *Conioselinum gmelini* is a synonym of *C. pacificum* (S. Wats.) C. & R. *Pedicularis surrecta* is a weak subspecies of *P. groenlandica* Retz. *Penstemon nemorosus*, after drifting interminably between this genus and *Chelone*, was recently transferred, with good reason, to a new genus, as *Nothochelone nemorosa* (Dougl. ex Lindl.) Straw. *Veronica alpina* var. *alterniflora* is used for what is generally treated as *V. wormskjoldii* R. & S.; although its distinctions are subtle, this seems to be a valid species; Fernald's varieties are, in any event, simply extremes of random variation. The showy montane *Erigeron peregrinus* (Pursh) Greene is listed as *E. salsuginosus*, long known to be based on a quite different plant.

It is clear that serious students will have to annotate their copies of this book carefully if it is to serve them reliably. Nevertheless it will certainly help to break the back of field identification except in the excluded families.

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A Continent in Danger

By VINCENT SERVENTY. Reynal & Company, New York. 1966. pp.

Vincent Serventy is an Australian naturalist, with recognized talents as a photographer, lecturer and writer. His enthusiasm for the great southern continent's wildlife and wilderness is enormous and contagious. His book "A Continent in Danger" provides a graphic and accurate accounting of Australia's unique animals, of many of the environmental factors necessary for their existence, and of the dangers which beset both wildlife and wilderness in an expanding industrial and agricultural society. But this is no mere catalogue. It is profusely and entertainingly illustrated by vignettes from the author's own great experience and by his splendid photographs in colour and black and white. Where the author's own knowledge has been lacking he has drawn freely on that available from his many friends in Australia's community of biologists and naturalists.

The book maintains high reader interest through fascinating sketches of the continent's unique fauna and flora as seen through the eyes of a skilled observer. Vin Serventy is at his best when recounting personal experiences—and he has had many. A case in point is the noisy scrub bird, first collected in 1842, last collected in 1889, and the object of sometimes intensive search by optomistic ornithologists until it was rediscovered in 1961. Serventy was involved in several systematic searches and was on the scene soon after the rediscovery to see and hear the birds.

There are minor imperfections which need discourage no buyer or reader. There are a few typographical errors. In a few places the text is difficult to follow, because the author assumes greater knowledge of Australian conditions than is warranted with most readers.

"A Continent in Danger" is a book with a purpose far beyond that of mere entertainment. It is a direct and informed plea for conservation, and for an appreciation of the irreplaceable values being lost each time an endemic animal is placed on the list of extinct or endangered species. Since white settlement in 1778 six species of marsupials are thought to have become extinct; about forty per

cent are now on the verge of extinction. Two Australian birds are extinct and a number are greatly endangered, largely through destruction of their habitat for agricultural purposes. Only about five per cent of Australia's land mass is under state protection. All Australian forests are biologically unique and interesting. Some must be among the most impressive in the world. In the mind of the present writer the giant karri forests of southwest Australia, with their abundance of animals, birds and blossoms, are just as impressive and far more interesting that the world famous redwood and Douglas fir stands of western North America. Their long range economic and aesthetic potential in a national park will never be met if their destruction for timber has proceeded as it had when I saw them in 1960.

Particular coverage is given to the introduction of exotic animals and plants into Australia, the impact which they have had on indigenous forms, the impact of agricultural and forestry practices on wildlife, and the widespread use of poisons (directed mainly against rabbits and dingos) and modern pesticides. Many of the problems have analogies elsewhere in the world, but Australian wilderness and wildlife frequently seem more vulnerable than that of other continents. The dangers are very real and action, in many cases, is long overdue.

Yet Vin Serventy is a practical conservationist. He realizes that an expanding society has legitimate demands upon the Australian environment. His plea is for rational use of the land and its natural resources, where they must be used, and for the establishment of national parks, nature reserves, wilderness areas and other sorts of reserves to ensure the preservation of representative portions of the natural environment and its contents. He points out that progress is being made.

The koala was once hunted to the verge of extinction for sport and hides. It has thrived under protection, on islands and elsewhere, to the point where some preserves have been overbrowsed, and where many animals have been reintroduced into areas where a now sympathetic citizenry will protect them. There are other such examples, but there are too many cases where unique forms of life are still in jeopardy.

John P. Kelsall

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Wildlife in Canada

By R. D. Lawrence. Michael Joseph Limited, London. 211 pp. $6.00.

The author has travelled widely observing wildlife in Canada, and this book is a compendium of his personal experiences and reading. It is definitely not an exhaustive study of the subject, for that kind of treatment would require several books.

Although the title implies all-inclusive treatment, most of the author's writing deals with wildlife in central Canada. He should, perhaps, have restricted himself to a more thorough treatment of the animals he knows best in that area.

The author's preoccupation with birth and death in his rather anthropomorphic treatment of life histories is not characteristic of modern wildlife writing. Also, it is unfortunate that a list of references was not included to establish the authenticity of certain statements. For example, mention of such exceptional individuals as a 3000-pound male bison, 1500-pound male polar bear, and 80-pound beaver should be documented, particularly when they are being implied as average for the species.

The author's use of the words coyote, wolf, and brush wolf for the same animal is unfortunate and there are other in-

stances where the reader may find himself confused. For example, the coyote is mistakenly described as predominantly a northern bush or mountain animal. As a result of these rather confusing statements this book, although it was written for the layman, may in fact create misconceptions about wildlife in Canada.

The paper is rather unattractive, but the type is quite readable. The book is enhanced greatly by photographs, the sources of which are not mentioned.

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Freshwater Fishes of Eastern Canada

By W. B. SCOTT. University of Toronto Press, Toronto 5, Ontario. 1967, second edition, x + 137 pp., illus. $2.25.

Anglers, naturalists, and students of ichthyology will appreciate this revised edition. Previous users will know its format with headings: *Other common names*, *Distinguishing features*, *Size*, *Occurrence*, *Life history and habits*, *Food*, and *Comments*. These sections are distilled to a single paragraph in the case of less important or more poorly known fishes. Most of the accounts are accompanied by photos by W. A. Carrick, usually from life. These include some of the finest published photos of North American freshwater fishes. Included, as before, are drawings showing those external parts of fishes useful in identification, a map of eastern Canada, and an index.

In comparing the new and the old editions one finds many worthwhile changes. There are now 137 pages of text as opposed to the previous 128, and fewer of these pages have blank spaces. Eight species accounts and 3 photos have been added. One hundred and fifty-four species are mentioned; there are accounts for 151. The nomenclature is brought up-to-date and common names in French are now included. A notable addition is a key to families and keys to species of the salmon and minnow families. Unlike many new editions, there has been no loss of quality in reproduction of the figures, in fact some are improved.

The mat paper of the 1954 edition has been replaced with glossy. Glossy paper, I find, is hard on the eyes, and if wetted, waterspots. A new plasticized artistic cover identifies the second edition. It is a pleasure to note the reasonable price.

D. E. MCALLISTER

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National Museum of Canada
Ottawa

The Illustrated Flora of Illinois: Ferns

By ROBERT H. MOHLENBROCK. Southern Illinois University Press, Carbondale and Edwardsville. 1967. xv—191 pp. $8.00 (US).

The title of this book is misleading because both ferns and fern allies are treated in it. Botanists and particularly students of ferns, both amateur and professional, will however be pleased to see this first of a proposed series of illustrated volumes on the plants of Illinois.

In this book a total of 87 species, varieties and hybrids known to occur in Illinois, are well illustrated by line drawings. The accompanying text gives descriptions of the various taxa, together with the common name, habitat, overall range, distribution in Illinois and other helpful notes. Distribution maps depict the occurrence of each species in the various counties of the state. An attempt has been made to assess the correct names to be used for these nomenclaturally difficult plants, and an extensive synonomy is included. One new variety is proposed: *Lycopodium lucidulum* Michx.

var. *tryonii* Mohlenbrock. Since this is only a phase with entire leaves which might occur anywhere throughout the range of the species it might however have better been given the rank of forma.

Chromosome counts are given for many of the species—a useful feature. References for some of these counts are given, but there is no indication as to whether or not the counts were made on Illinois material.

This book will be a useful addition to the libraries of residents of Illinois and adjacent states as well as to phytogeographers in all parts of the world. Ontario users will find all of the common as well as many of the rarer taxa found in that province.

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OTHER NEW TITLES

The following titles are offered as a service to readers. Their listing does not preclude them from possible review in a future issue of the Canadian Field-Naturalist.

The Urgent Future: People, Housing, City Region. Albert Mayer. McGraw-Hill, New York. 1967. 198 p. Illus. $16.50 (US).

Travels and Traditions of Waterfowl. H. Albert Hochbaum. Univ. of Minnesota Press, Minneapolis. 1967. 313 p. Illus. Paperback. $2.95 (US). Reprint, 1966 edition.

World Climate from 8000 to 0 B.C. Proceedings of an international symposium, London, April, 1966. J. S. Sawyer (Ed.). Royal Meteorological Soc., London. 1967. 231 p. Illus. Paperback. $8.80 (US).

The Symphony of Life. Donald Hatch Andrews. Unity Books, Lee's Summit, Missouri. 1967. 423 p. Illus. $4.95 (US).

Terrestrial Life of Antarctica. S. W. Greene, J. L. Gressitt, D. Koob, G. A. Llano, E. D. Rudolph, R. Singer, W. C. Steere, and F. C. Ugolini. American Geographical Society, New York. 1967. 24 p. 11 maps. Illus. $7.50 (US). Antarctica Map Folio Series, No. 5.

The Theory of Island Biogeography. Robert H. MacArthur and Edward O. Wilson. Princeton Univ. Press, Princeton, N.J. 1967. 203 p. Illus. Cloth. $8.00 (US). Paperback. $3.95 (US). Monographs in Population Biology.

Advances in Ecological Research. Volume 4. J. B. Cragg (Ed.). Academic Press, New York. 1967. 323 p. Illus. $13.50 (US).

Animals of the North. William O. Pruitt. Harper and Row, New York. 1967. 183 p. Illus. $5.95 (US).

The Bering Land Bridge. Based on a symposium given at the 7th Congress of the International Association for Quaternary Research (Boulder, Colorado), August — September, 1965. David M. Hopkins (Ed.). Stanford Univ. Press, Stanford, California. 1967. 511 p. Illus. $18.50 (US). Twenty-four papers.

In Wildness is the Preservation of the World. Selections and photographs by Eliot Porter. Sierra Club — Ballantine Books, New York. 1967. 159 p. Illus. Paperback. $3.95 (US).

Insecticides, Action and Metabolism. R. D. O'Brien. Academic Press, New York. 1967. 332 p. Illus. $14.00 (US).

The Land, Wildlife and Peoples of the Bible. Peter Farb. Harper and Row, New York. 1967. 171 p. Illus. $3.95 (US).

Population Growth and Land Use. Colin Clark. Macmillan, London; St. Martin's, New York. 1967. 406 p. Illus. $14.00 (US).

Proceedings of the Symposium on the Biology of the California Islands. Ralph N. Philbrick (Ed.). Santa Barbara Botanic Garden. 1967. 363 p. Illus. $10.00 (US).

The Adaptable Black Bear. J. R. Matson. Dorrance, Philadelphia. 1967. 146 p. Illus. $4.00 (US).

Ants from Close Up. L. Hugh Newman. Photographs by Stephen Dalton and others. Crowell, New York. 1967. 112 p. Illus. $6.95 (US).

The Biology of Aquatic Vascular Plants. C. D. Sculthorpe. St. Martin's, New York. 1967. 610 p. Illus. $23.00 (US).

Dictionary of Alaska Place Names. Donald J. Orth. U.S. Geological Survey Professional Paper 567, Washington, D.C. 1967 (available from Superintendent of Documents, Washington, D.C.). 1084 p. Illus. $8.50 (US).

The Natural History of Viruses. C. H. Andrewes. Norton, New York. 1967. 245 p. Illus. $8.50 (US).

Plants and Man on the Seychelles Coast. A study in Historical Biogeography. Jonathan D. Saver. Univ. of Wisconsin Press, Madison, Wisconsin. 1967. 148 p. Illus. $5.00 (US).

The Ecology of Insect Populations in Theory and Practice. L. R. Clarke, P. W. Geier, R. D. Hughes, and R. F. Morris. Methuen, London; Barnes and Noble, New York. 1967. 246 p. Illus. $8.00 (US).

The Genus Pinus. N. T. Mirov. Ronald Press, New York. 1967. 610 p. Illus. $15.00 (US).

Light as an Ecological Factor. British Ecological Society Symposium No. 6, Cambridge, March-April 1965. R. Bainbridge, G. C. Evans, and O. Rackham (Eds.). Wiley, New York. 1967. 464 p. Illus. $13.50 (US).

The Birds of America. Seven Volumes. John James Audubon. With a new introduction by Dean Amadon. Dover, New York. 1967. Reprints. Volume 1, 262 p.; volume 2, 205 p.; volume 3, 233 p.; volume 4, 321 p.; volume 5, 346 p.; volume 6, 457 p.; volume 7, 400 p. Illus. Paperback. $2.50 per volume. Originals published 1840 to 1844.

The Genera of Flowering Plants (Angiospermae). Volume 2, Dicotyledones. J. Hutchinson. Oxford Univ. Press, New York. 1967. 669 p. $30.40 (US).

The Life of Rivers and Streams. Robert L. Usinger. McGraw-Hill, New York. 1967. 232 p. Illus. $4.95 (US). Our Living World of Nature Series.

Lizard Ecology: A Symposium. William W. Milstead (Ed.). Univ. of Missouri Press, Columbia. 1967. 312 p. Illus. $7.50 (US). Includes 9 papers of a symposium at Kansas City, Missouri.

The Book of Reptiles and Amphibians. Michael H. Bevans. Doubleday. 1967. 86 p. 100 illus. by author. $4.50 US).

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Carl Linnaeus: Pioneer of Modern Botany. Alice Dickinson. F. Watts. 1967. 209 p. Illus. $2.95 (US).

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Natural Resources: Quality and Quantity. S. V. Ciriacy-Wantrup and James J. Parsons (Eds.). Univ. of Calif. Press. 1967. 217 p. 10 plates. $6.50 (US).

Plant Variation and Classification. C. Ritchie Bell. Wadsworth Pub. Co. 1967. 135 p. Illus by Susan Carleton Smith. Paperback. $1.95 (US).

Formulation of Research Policies: Collected Papers from an International Symposium. Lawrence W. Bass and Bruce S. Old (Eds.). AAAS. 1967. 210 p. Illus. $7.75 (US).

A Book of Canadian Birds. Charles Paul May. Illus. by John Crosby. Macmillan of Canada, Toronto. 1967. 115 p. $3.25.

Living Plants of the World. Lorus and Margery Milne. Random House. 1967. 336 p. 340 photographs (176 in color). $15.00 (US).

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Bird Songs in Literature. Joseph Wood Krutch and the Cornell Laboratory of Ornithology. Houghton. 1967. 33⅓ rpm record. 8 p. text. $6.00 (US).

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Federal Support for Academic Science and Other Educational Activities in Universities and Colleges: Fiscal Years, 1963-66. National Science Foundation, GPO. 1967. 137 p. Paperback. 70c (US).

Governing Nature. Earl Finbar Murphy. Quadrangle Bks. 1967. 333 p. $7.50 (US).

The Imperial Collection of Audubon Animals: The Quadrupeds of North America. Original text by John James Audubon and John Bachman, new text by Victor H. Cahalane (Ed.), foreword by Fairfield Osborn. Hammond. 1967. 307 p. Illus. by John James Audubon and John Woodhouse Audubon. $19.95 (US).

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Gods, Graves and Scholars: The Story of Archaeology. C. W. Ceram, transl. from German by E. B. Garside and Sophie Wilkins. Knopf. 2nd ed. 1967. 455 p. 24 plates. Illus. Maps. $7.95 (US).

Amphibians and Reptiles of Great Smoky Mountains National Park. James E. Huheey and Arthur Stupka. Photographs by Isabelle Hunt Conant. Published with the cooperation of the Great Smoky Mountains Natural History Association, University of Tennessee Press, Knoxville. 1967. 98 p. $3.00 (US).

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The Lupines of Canada and Alaska. David B. Dunn and J. M. Gillett. Research Branch, Canada Department of Agriculture, Monograph No. 2. 1966. Illus. Maps. 89 p. $2.00.

Gamebirds of Southern Africa. Being a Guide to All the Major Sporting Birds of Africa South of the Cunene, Okavango and Zambezi Rivers. P. A. Clancey. Elsevier, New York. 1967. 224 p. Illus. $15.75 (US).

Great National Parks of the World. Richard Carrington. Random House, New York. 1967. 240 p. Illus. $20.00 (US).

Proceedings of the 57th Western Forestry Conference; Forest Land Use — Great Decisions in the Making, 1966. Western Forestry and Conserv. Assoc., American Bank Bldg., Portland, Ore. 97205. 1967. 110 p. Illus.

Future Environments of North America: Transformation of a Continent. F. Fraser Darling and John P. Milton (Eds.). The Conservation Foundation, 1250 Connecticut Ave., N.W., Washington, D.C. 20036. The Natural History Press. 767 p.

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